Part No. 08160SL (Rev. B)

# Service Manual

# Workman® MD & MDX

## Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Workman MD and Workman MDX.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manual and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.

**This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.**

**NOTE:** A **NOTE** will give general information about the correct operation, maintenance, service, testing or repair of the machine.

**IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.**

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# Chapter 1

# Safety

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# Safety Instructions

The Workman MD and MDX series vehicles are designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death.

Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with all controls and know how to stop it quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

**The safety alert symbol means CAUTION, WARNING or DANGER — "personal safety instruction". Read and understand the instruction because it has to do with safety. Failure to comply with the instruction may result in personal injury.**

**WARNING**

**To reduce the potential for injury or death, comply with the following safety instructions.**

**WARNING**

**The Workman is an off-highway vehicle only. It is not designed, equipped or manufactured for use on public streets, roads or highways.**

## Supervisor's Responsibilities

1. Make sure operators are thoroughly trained and familiar with the Operator's Manual and all labels on the vehicle.

2. Be sure to establish your own special procedures and work rules for unusual operating conditions (e.g. slopes too steep for vehicle operation).

## Before Operating

1. Read and understand the contents of the Operator's Manual and Operator's DVD before starting and operating the vehicle. Become familiar with the controls and know how to stop the vehicle and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the vehicle. Also, tighten any loose nuts, bolts or screws to ensure vehicle is in safe operating condition.

3. Since fuel used in Workman vehicles is highly flammable, handle it carefully:

   A. Store fuel in containers specifically designed for this purpose.

   B. Do not remove vehicle fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.

   E. Clean up any spilled fuel.

## While Operating

1. Sit on the operator seat when starting and operating the vehicle.

2. Before starting the engine:

   A. Sit on operator's seat and apply the parking brake.

   B. Turn ignition key to ON.

   C. Depress accelerator pedal to start engine and engage drive system.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, muffler or exhaust pipe while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Stop movement of the vehicle.

   B. Turn ignition key to OFF and wait for all movement to stop.

   C. Remove key from ignition switch.

   D. Apply parking brake.

   E. Do not park on slopes unless wheels are chocked or blocked.

## Maintenance and Service

1. Before servicing or making adjustments, turn all accessories off, release pressure from accelerator pedal, allow engine to stop, set parking brake and remove key from the ignition switch.

2. Make sure vehicle is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Never store the vehicle or fuel container inside where there is an open flame, such as near a water heater or furnace.

4. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.

5. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt.

6. If engine must be running to perform maintenance or an adjustment, keep clothing, hands, feet and other parts of the body away from moving parts. Keep bystanders away.

7. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.

8. Shut engine off before checking or adding oil to the engine crankcase.

9. Disconnect battery before servicing the vehicle. Disconnect negative (–) battery cable first and positive (+) cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive (+) cable first and negative (–) cable last.

10. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

11. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

12. To assure optimum performance and continued safety of the vehicle, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in nonconformance with safety standards, and the warranty may be voided.

13. When raising the vehicle to change tires or to perform other service, use correct blocks, hoists and jacks. Make sure vehicle is parked on a solid level surface such as a concrete floor. Prior to raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle. Always chock or block wheels. Use appropriate jack stands to support the raised vehicle. If the vehicle is not properly supported by jack stands, the vehicle may move or fall, which may result in personal injury (see Jacking Instructions in this section).

14. Make sure to dispose of potentially harmful waste (e.g. fuel, oil, engine coolant, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.

# Jacking and Other Instructions

## Jack Vehicle

**DANGER**

**POTENTIAL HAZARD**
- **A vehicle that is not properly supported may become unstable.**

**WHAT CAN HAPPEN**
- **The vehicle may move or fall. Personal injury or damage to the machine may result.**

**HOW TO AVOID THE HAZARD**
- **Make sure vehicle is parked on a solid level surface, such as a concrete floor.**
- **Make sure engine is off and key is removed from the ignition switch before getting off the vehicle.**
- **Before raising the vehicle, remove any attachments that may interfere with the safe and proper raising of the vehicle.**
- **Always chock or block wheels to prevent the vehicle from rolling.**
- **Do not start vehicle while it is on jack stands without placing transaxle in neutral.**
- **Make sure proper hoists, jacks and jack stands are used to raise and support the vehicle.**

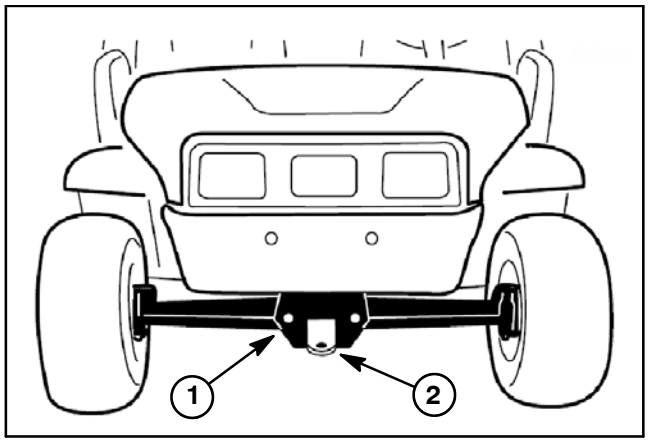


Figure 1

1. **Front frame**
2. **Towing tongue**

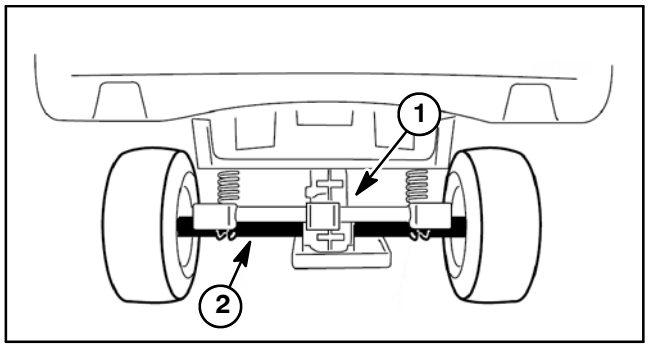


Figure 2

1. **Transaxle case**
2. **Axle tube**

### Jacking Locations

1. Jack front of the vehicle on the front of the frame and behind the towing tongue (Fig. 1).

2. Jack rear of the vehicle under each rear axle tube. Do not jack vehicle below the transaxle case (Fig. 2).

## Transport Vehicle

When moving the vehicle long distances, use a trailer or flatbed truck. Make sure vehicle is secured to the trailer properly. Refer to Operator's Manual for transport information.

## Tow Vehicle

**IMPORTANT: Frequent or long distance towing of the Workman is not recommended.**

In case of emergency, the vehicle can be towed for a **short** distance. Refer to Operator's Manual for towing information.

**IMPORTANT: If vehicle is towed, make sure that ignition switch is in the OFF position and key is removed from switch.**

## Transaxle Neutral Position

When performing routine maintenance and/or engine testing, the transaxle must be shifted into the neutral position.

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Move shift lever to the neutral position (Fig. 3).

3. Make sure transaxle is in the neutral position by rotating the driven clutch. The tires should not rotate. If tire rotation does occur, see Adjust Shift Cables in the Adjustment section of Chapter 5 – Drive Train.

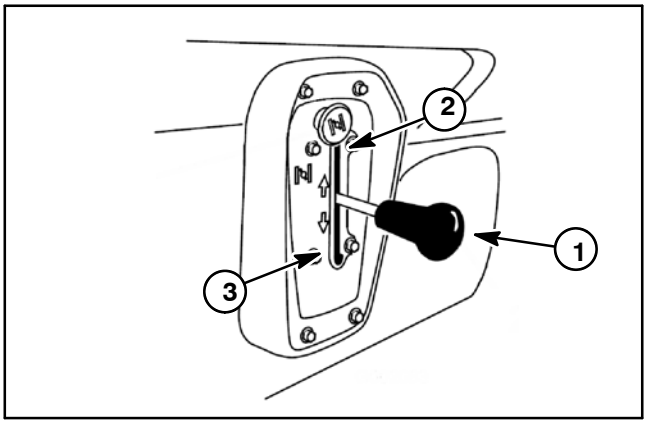


Figure 3

1. **Shift lever (in neutral)**
2. **Forward position**
3. **Reverse position**

# Safety and Instruction Decals

Numerous safety and instruction decals are affixed to your Workman. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in the Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

Chapter 2

# Product Records and Maintenance



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## Product Records

Insert Operator's Manual and Parts Catalog for your Workman at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

## Maintenance

Maintenance procedures and recommended service intervals for your Workman are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance.

# Equivalents and Conversions

## Decimal and Millimeter Equivalents

| Fractions | Decimals | mm | Fractions | Decimals | mm |
|---|---|---|---|---|---|
| 1/64 | 0.015625 | — 0.397 | 33/64 | 0.515625 | — 13.097 |
| 1/32 | 0.03125 | — 0.794 | 17/32 | 0.53125 | — 13.494 |
| 3/64 | 0.046875 | — 1.191 | 35/64 | 0.546875 | — 13.891 |
| 1/16 | 0.0625 | — 1.588 | 9/16 | 0.5625 | — 14.288 |
| 5/64 | 0.078125 | — 1.984 | 37/64 | 0.578125 | — 14.684 |
| 3/32 | 0.09375 | — 2.381 | 19/32 | 0.59375 | — 15.081 |
| 7/64 | 0.109275 | — 2.778 | 39/64 | 0.609375 | — 15.478 |
| **1/8** | 0.1250 | — 3.175 | **5/8** | 0.6250 | — 15.875 |
| 9/64 | 0.140625 | — 3.572 | 41/64 | 0.640625 | — 16.272 |
| 5/32 | 0.15625 | — 3.969 | 21/32 | 0.65625 | — 16.669 |
| 11/64 | 0.171875 | — 4.366 | 43/64 | 0.671875 | — 17.066 |
| 3/16 | 0.1875 | — 4.762 | 11/16 | 0.6875 | — 17.462 |
| 13/64 | 0.203125 | — 5.159 | 45/64 | 0.703125 | — 17.859 |
| 7/32 | 0.21875 | — 5.556 | 23/32 | 0.71875 | — 18.256 |
| 15/64 | 0.234375 | — 5.953 | 47/64 | 0.734375 | — 18.653 |
| **1/4** | 0.2500 | — 6.350 | **3/4** | 0.7500 | — 19.050 |
| 17/64 | 0.265625 | — 6.747 | 49/64 | 0.765625 | — 19.447 |
| 9/32 | 0.28125 | — 7.144 | 25/32 | 0.78125 | — 19.844 |
| 19/64 | 0.296875 | — 7.541 | 51/64 | 0.796875 | — 20.241 |
| 5/16 | 0.3125 | — 7.938 | 13/16 | 0.8125 | — 20.638 |
| 21/64 | 0.328125 | — 8.334 | 53/64 | 0.828125 | — 21.034 |
| 11/32 | 0.34375 | — 8.731 | 27/32 | 0.84375 | — 21.431 |
| 23/64 | 0.359375 | — 9.128 | 55/64 | 0.859375 | — 21.828 |
| **3/8** | 0.3750 | — 9.525 | **7/8** | 0.8750 | — 22.225 |
| 25/64 | 0.390625 | — 9.922 | 57/64 | 0.890625 | — 22.622 |
| 13/32 | 0.40625 | — 10.319 | 29/32 | 0.90625 | — 23.019 |
| 27/64 | 0.421875 | — 10.716 | 59/64 | 0.921875 | — 23.416 |
| 7/16 | 0.4375 | — 11.112 | 15/16 | 0.9375 | — 23.812 |
| 29/64 | 0.453125 | — 11.509 | 61/64 | 0.953125 | — 24.209 |
| 15/32 | 0.46875 | — 11.906 | 31/32 | 0.96875 | — 24.606 |
| 31/64 | 0.484375 | — 12.303 | 63/64 | 0.984375 | — 25.003 |
| **1/2** | 0.5000 | — 12.700 | **1** | 1.000 | — 25.400 |

**1 mm = 0.03937 in.** **0.001 in. = 0.0254 mm**

## U.S.to Metric Conversions

| | To Convert | Into | Multiply By |
|---|---|---|---|
| **Linear Measurement** | Miles | Kilometers | 1.609 |
| | Yards | Meters | 0.9144 |
| | Feet | Meters | 0.3048 |
| | Feet | Centimeters | 30.48 |
| | Inches | Meters | 0.0254 |
| | Inches | Centimeters | 2.54 |
| | Inches | Millimeters | 25.4 |
| **Area** | Square Miles | Square Kilometers | 2.59 |
| | Square Feet | Square Meters | 0.0929 |
| | Square Inches | Square Centimeters | 6.452 |
| | Acre | Hectare | 0.4047 |
| **Volume** | Cubic Yards | Cubic Meters | 0.7646 |
| | Cubic Feet | Cubic Meters | 0.02832 |
| | Cubic Inches | Cubic Centimeters | 16.39 |
| **Weight** | Tons (Short) | Metric Tons | 0.9078 |
| | Pounds | Kilograms | 0.4536 |
| | Ounces (Avdp.) | Grams | 28.3495 |
| **Pressure** | Pounds/Sq. In. | Kilopascal | 6.895 |
| | Pounds/Sq. In. | Bar | 0.069 |
| **Work** | Foot-pounds | Newton-Meters | 1.356 |
| | Foot-pounds | Kilogram-Meters | 0.1383 |
| | Inch-pounds | Kilogram-Centimeters | 1.152144 |
| **Liquid Volume** | Quarts | Liters | 0.9463 |
| | Gallons | Liters | 3.785 |
| **Liquid Flow** | Gallons/Minute | Liters/Minute | 3.785 |
| **Temperature** | Fahrenheit | Celsius | 1. Subract 32°<br>2. Multiply by 5/9 |

# Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.



## Fastener Identification

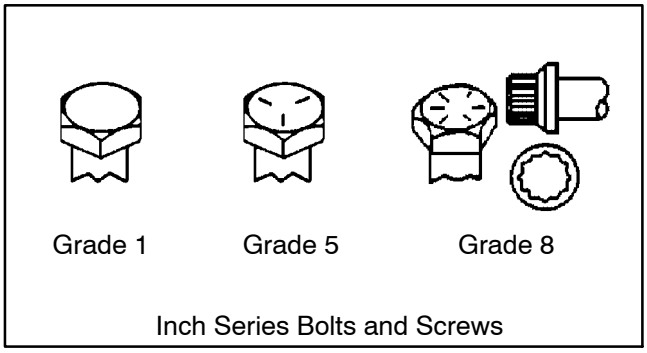


Figure 1

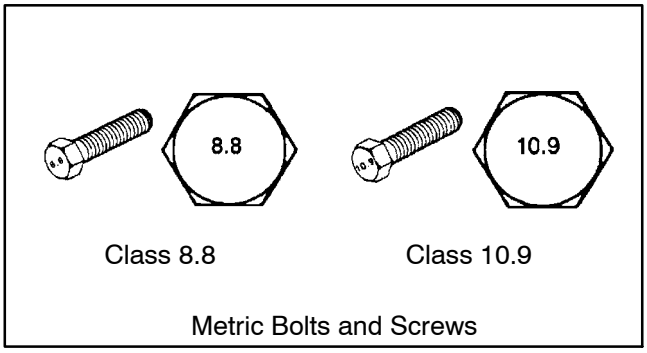


Figure 2

## Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

| Thread Size | Grade 1, 5 & 8 with Thin Height Nuts | SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | | SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts) | | SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts) | |
|---|---|---|---|---|---|---|---|
| | **in-lb** | **in-lb** | **N-cm** | **in-lb** | **N-cm** | **in-lb** | **N-cm** |
| # 6 - 32 UNC | 10 ± 2 | 13 ± 2 | 147 ± 23 | 15 ± 2 | 170 ± 20 | 23 ± 2 | 260 ± 20 |
| # 6 - 40 UNF | | | | 17 ± 2 | 190 ± 20 | 25 ± 2 | 280 ± 20 |
| # 8 - 32 UNC | 13 ± 2 | 25 ± 5 | 282 ± 30 | 29 ± 3 | 330 ± 30 | 41 ± 4 | 460 ± 45 |
| # 8 - 36 UNF | | | | 31 ± 3 | 350 ± 30 | 43 ± 4 | 485 ± 45 |
| # 10 - 24 UNC | 18 ± 2 | 30 ± 5 | 339 ± 56 | 42 ± 4 | 475 ± 45 | 60 ± 6 | 675 ± 70 |
| # 10 - 32 UNF | | | | 48 ± 4 | 540 ± 45 | 68 ± 6 | 765 ± 70 |
| 1/4 - 20 UNC | 48 ± 7 | 53 ± 7 | 599 ± 79 | 100 ± 10 | 1125 ± 100 | 140 ± 15 | 1580 ± 170 |
| 1/4 - 28 UNF | 53 ± 7 | 65 ± 10 | 734 ± 113 | 115 ± 10 | 1300 ± 100 | 160 ± 15 | 1800 ± 170 |
| 5/16 - 18 UNC | 115 ± 15 | 105 ± 17 | 1186 ± 169 | 200 ± 25 | 2250 ± 280 | 300 ± 30 | 3390 ± 340 |
| 5/16 - 24 UNF | 138 ± 17 | 128 ± 17 | 1446 ± 192 | 225 ± 25 | 2540 ± 280 | 325 ± 30 | 3670 ± 340 |
| | **ft-lb** | **ft-lb** | **N-m** | **ft-lb** | **N-m** | **ft-lb** | **N-m** |
| 3/8 - 16 UNC | 16 ± 2 | 16 ± 2 | 22 ± 3 | 30 ± 3 | 41 ± 4 | 43 ± 4 | 58 ± 5 |
| 3/8 - 24 UNF | 17 ± 2 | 18 ± 2 | 24 ± 3 | 35 ± 3 | 47 ± 4 | 50 ± 4 | 68 ± 5 |
| 7/16 - 14 UNC | 27 ± 3 | 27 ± 3 | 37 ± 4 | 50 ± 5 | 68 ± 7 | 70 ± 7 | 95 ± 9 |
| 7/16 - 20 UNF | 29 ± 3 | 29 ± 3 | 39 ± 4 | 55 ± 5 | 75 ± 7 | 77 ± 7 | 104 ± 9 |
| 1/2 - 13 UNC | 30 ± 3 | 48 ± 7 | 65 ± 9 | 75 ± 8 | 102 ± 11 | 105 ± 10 | 142 ± 14 |
| 1/2 - 20 UNF | 32 ± 3 | 53 ± 7 | 72 ± 9 | 85 ± 8 | 115 ± 11 | 120 ± 10 | 163 ± 14 |
| 5/8 - 11 UNC | 65 ± 10 | 88 ± 12 | 119 ± 16 | 150 ± 15 | 203 ± 20 | 210 ± 20 | 285 ± 27 |
| 5/8 - 18 UNF | 75 ± 10 | 95 ± 15 | 129 ± 20 | 170 ± 15 | 230 ± 20 | 240 ± 20 | 325 ± 27 |
| 3/4 - 10 UNC | 93 ± 12 | 140 ± 20 | 190 ± 27 | 265 ± 25 | 359 ± 34 | 375 ± 35 | 508 ± 47 |
| 3/4 - 16 UNF | 115 ± 15 | 165 ± 25 | 224 ± 34 | 300 ± 25 | 407 ± 34 | 420 ± 35 | 569 ± 47 |
| 7/8 - 9 UNC | 140 ± 20 | 225 ± 25 | 305 ± 34 | 430 ± 45 | 583 ± 61 | 600 ± 60 | 813 ± 81 |
| 7/8 - 14 UNF | 155 ± 25 | 260 ± 30 | 353 ± 41 | 475 ± 45 | 644 ± 61 | 660 ± 60 | 895 ± 81 |

**NOTE:** Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

**NOTE:** The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

## Standard Torque for Dry, Zinc Plated and Steel Fasteners (Metric Fasteners)

| Thread Size | Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts) | | Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts) | |
|---|---|---|---|---|
| M5 X 0.8 | 57 ± 5 in-lb | 640 ± 60 N-cm | 78 ± 7 in-lb | 885 ± 80 N-cm |
| M6 X 1.0 | 96 ± 9 in-lb | 1018 ± 100 N-cm | 133 ± 13 in-lb | 1500 ± 150 N-cm |
| M8 X 1.25 | 19 ± 2 ft-lb | 26 ± 3 N-m | 27 ± 2 ft-lb | 36 ± 3 N-m |
| M10 X 1.5 | 38 ± 4 ft-lb | 52 ± 5 N-m | 53 ± 5 ft-lb | 72 ± 7 N-m |
| M12 X 1.75 | 66 ± 7 ft-lb | 90 ± 10 N-m | 92 ± 9 ft-lb | 125 ± 12 N-m |
| M16 X 2.0 | 166 ± 15 ft-lb | 225 ± 20 N-m | 229 ± 22 ft-lb | 310 ± 30 N-m |
| M20 X 2.5 | 325 ± 33 ft-lb | 440 ± 45 N-m | 450 ± 37 ft-lb | 610 ± 50 N-m |

**NOTE:** Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

**NOTE:** Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

**NOTE:** The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

## Other Torque Specifications

**SAE Grade 8 Steel Set Screws**

| Thread Size | Recommended Torque | |
|---|---|---|
| | Square Head | Hex Socket |
| 1/4 – 20 UNC | 140 ± 20 in–lb | 73 ± 12 in–lb |
| 5/16 – 18 UNC | 215 ± 35 in–lb | 145 ± 20 in–lb |
| 3/8 – 16 UNC | 35 ± 10 ft–lb | 18 ± 3 ft–lb |
| 1/2 – 13 UNC | 75 ± 15 ft–lb | 50 ± 10 ft–lb |

**Wheel Bolts and Lug Nuts**

| Thread Size | Recommended Torque** | |
|---|---|---|
| 7/16 – 20 UNF Grade 5 | 65 ± 10 ft–lb | 88 ± 14 N–m |
| 1/2 – 20 UNF Grade 5 | 80 ± 10 ft–lb | 108 ± 14 N–m |
| M12 X 1.25 Class 8.8 | 80 ± 10 ft–lb | 108 ± 14 N–m |
| M12 X 1.5 Class 8.8 | 80 ± 10 ft–lb | 108 ± 14 N–m |

** For steel wheels and non–lubricated fasteners.

**Thread Cutting Screws (Zinc Plated Steel)**

| Type 1, Type 23 or Type F | |
|---|---|
| **Thread Size** | **Baseline Torque*** |
| No. 6 – 32 UNC | 20 ± 5 in–lb |
| No. 8 – 32 UNC | 30 ± 5 in–lb |
| No. 10 – 24 UNC | 38 ± 7 in–lb |
| 1/4 – 20 UNC | 85 ± 15 in–lb |
| 5/16 – 18 UNC | 110 ± 20 in–lb |
| 3/8 – 16 UNC | 200 ± 100 in–lb |

**Thread Cutting Screws (Zinc Plated Steel)**

| Thread Size | Threads per Inch | | Baseline Torque* |
|---|---|---|---|
| | Type A | Type B | |
| No. 6 | 18 | 20 | 20 ± 5 in–lb |
| No. 8 | 15 | 18 | 30 ± 5 in–lb |
| No. 10 | 12 | 16 | 38 ± 7 in–lb |
| No. 12 | 11 | 14 | 85 ± 15 in–lb |

* Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

## Conversion Factors

*in–lb X 11.2985 = N–cm*
**ft–lb X 1.3558 = N–m**

*N–cm X 0.08851 = in–lb*
**N–m X 0.7376 = ft–lb**

Chapter 3

# Briggs & Stratton Gasoline Engine

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BRIGGS & STRATTON REPAIR MANUAL FOR 4-CYCLE, V-TWIN CYLINDER, OHV HEAD ENGINES

# General Information

This Chapter gives information about specifications, maintenance, troubleshooting, testing and repair of the V–twin cylinder, gasoline engine used in the Workman MDX.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton Repair Manual for 4–Cycle, V–Twin Cylinder, OHV Head Engines. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs & Stratton engines are supplied through your local Toro distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

## Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman MDX vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

# Specifications

| Item | Description |
|---|---|
| Make / Designation | Briggs and Stratton, 4-cycle, V-Twin Cylinder, OHV, Air Cooled, Gasoline Engine - Model 303440 |
| Bore x Stroke | 2.68" x 2.60" (68 mm x 66 mm) |
| Total Displacement | 29.3 $in^3$ (480 cc) |
| Governor | Mechanical Governor |
| Carburetor | Float Feed, Single Barrel |
| Fuel Pump | Pulsating Crankcase Vacuum |
| Fuel | Unleaded, regular grade gasoline |
| Fuel Tank Capacity | 7.0 U.S. gal (26.5 l) |
| Lubrication System | Pressure Lubrication, Gear Driven Geroter Oil Pump |
| Crankcase Oil Capacity | 1.75 U.S. qt (1.66 l) with new filter |
| Engine Oil | See Operator's Manual |
| Ignition System | Flywheel magneto, twin electronic armatures |
| Spark Plugs | Champion RC 12YC (or equivalent) |
| Spark Plug Gap | 0.030" (0.76 mm) |
| Starter/Generator | 10.5 VDC 100 Amps/14 VDC and 23 Amps |
| Dry Weight (approximate) | 72 lb (32.4 kg) |

# Adjustments

## Adjust Throttle Cable

**NOTE:** The Workman MDX is equipped with an engine governor. Refer to the Briggs & Stratton Repair Manual at the end of this chapter for governor information on these machines.

Depressing the accelerator pedal rotates the engine governor bellcrank which tensions the main governor spring to increase engine speed. Releasing the accelerator pedal decreases governor spring tension to reduce engine speed.

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Lift cargo box and prop with rod to gain access to the engine.

3. When the accelerator pedal is fully depressed the engine governor bellcrank mechanism should have a gap from **0.030" to 0.080" (0.8 to 2.0 mm)** (Fig. 2). If necessary, adjust jam nuts on throttle cable so that gap is correct.

4. Make sure that shift lever is in the neutral position to prevent the machine from moving.

5. With ignition switch in the RUN position, depress accelerator pedal and allow engine to start. Fully depress accelerator pedal and have a second person measure engine speed with a tachometer. With pedal fully depressed, engine speed should be from **3250 to 3350 RPM**. If necessary, adjust throttle cable or engine governor so that engine speed is correct when the accelerator pedal is fully depressed.

6. After throttle cable adjustment is correct, lower and secure cargo box.

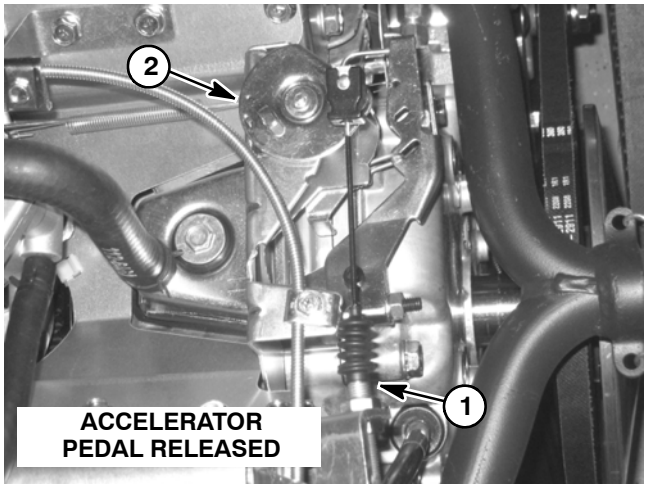


Figure 1

1. **Throttle cable**
2. **Governor bellcrank**

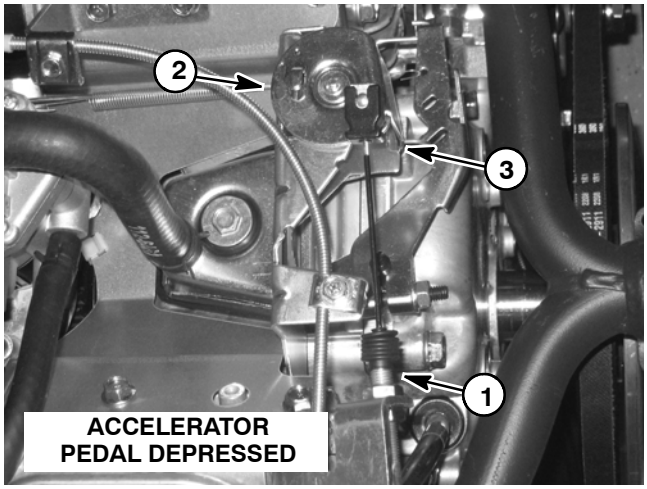


Figure 2

1. **Throttle cable**
2. **Governor bellcrank**
3. **Gap**

## Cooling System

To ensure proper engine cooling, make sure the grass screen, cooling fins and other external surfaces of the engine are kept clean at all times.

**NOTE:** Perform this maintenance procedure at the interval specified in the Operator's Manual.

**IMPORTANT: The engine that powers the Workman MDX is air-cooled. Operating the engine with dirty or plugged cooling fins or a plugged or dirty blower housing will result in engine overheating and damage.**

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Raise cargo box and support with prop rod.

3. Carefully remove spark plug wires from the spark plugs to prevent the engine from starting unexpectedly.

**IMPORTANT: Never clean engine with pressurized water. Water could enter and contaminate the fuel system.**

4. Clean cooling fins on both cylinder heads (Fig. 3).

5. Clean rotating screen and blower housing of dirt and debris.

6. If necessary remove rotating screen and blower housing from engine for more thorough engine cleaning.

**IMPORTANT: Never operate engine without the rotating screen and blower housing installed. Overheating and engine damage will result.**

7. Make sure rotating screen and blower housing are properly installed to the engine if removed.

8. Attach spark plug wires to spark plugs.

9. Lower and secure cargo box.

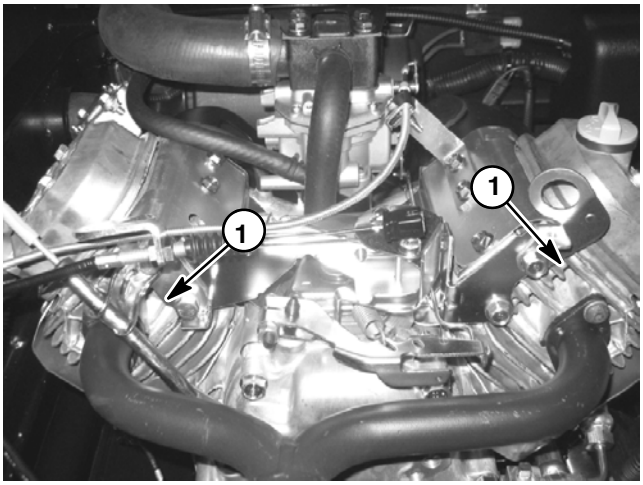


Figure 3

1. Cylinder head cooling fins

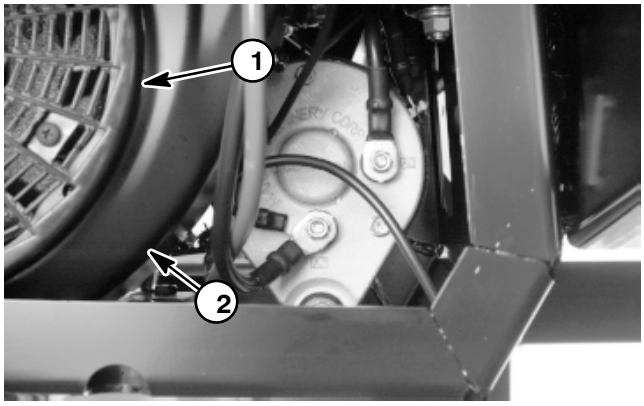


Figure 4

1. Rotating screen
2. Blower housing

## Air Cleaner

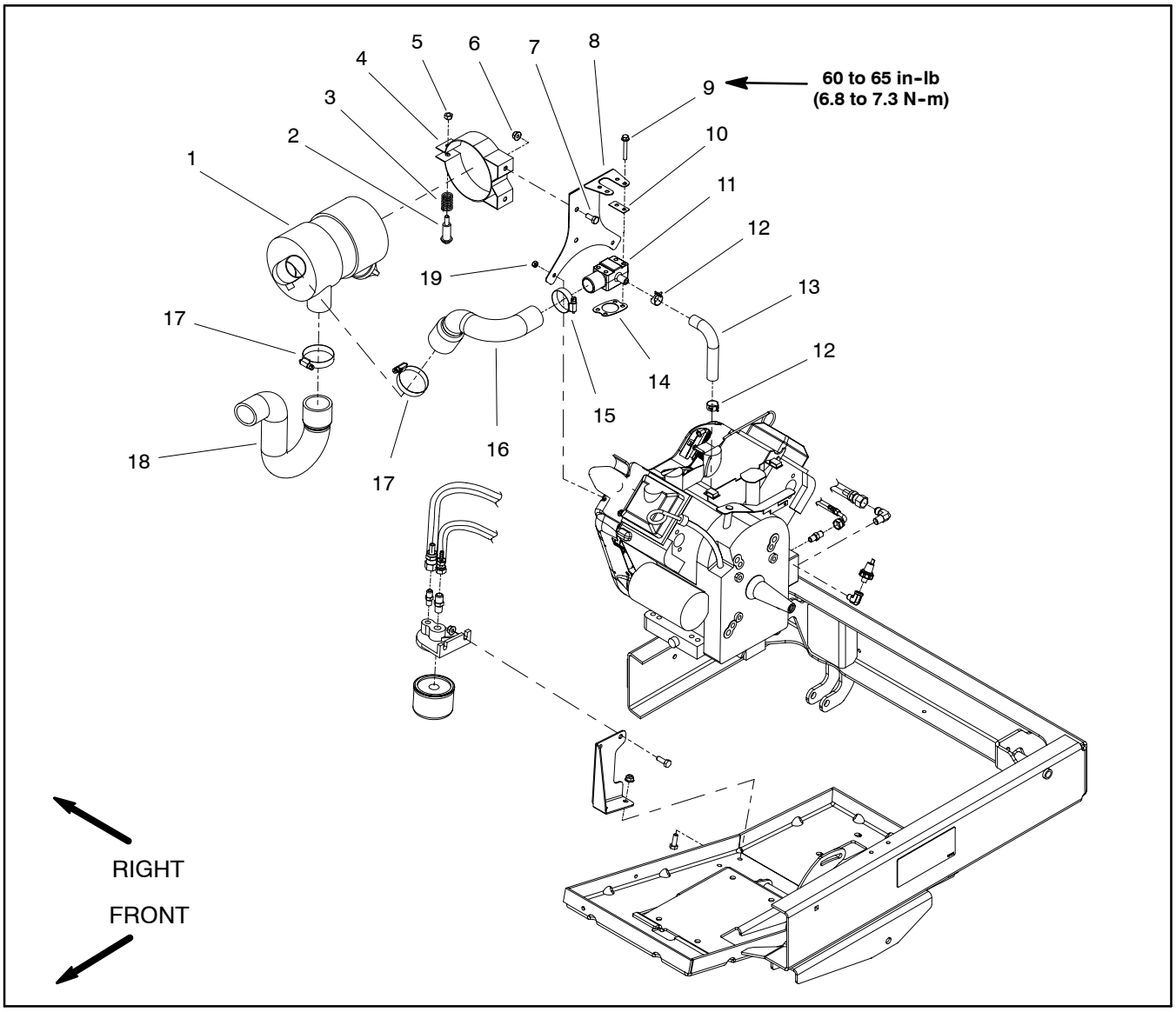


Figure 5

1. **Air cleaner assembly**
2. **Bolt**
3. **Compression spring**
4. **Mounting band**
5. **Nut**
6. **Flange nut (2 used)**
7. **Cap screw (2 used)**
8. **Air cleaner bracket**
9. **Flange head screw (4 used)**
10. **Carburetor gasket (2 used)**
11. **Carburetor adapter**
12. **Hose clamp**
13. **Breather hose**
14. **Adapter gasket**
15. **Hose clamp**
16. **Intake hose**
17. **Hose clamp**
18. **Intake hose**

**Removal (Fig. 5)**

1. Make sure machine is parked on a level surface with the engine OFF.

2. Raise cargo box and support with prop rod.

3. Thoroughly clean junction of intake hose and carburetor adapter on engine and air cleaner assembly.

4. Remove air cleaner components as needed using Figure 5 as a guide. Discard any removed gaskets and clean gasket mating surfaces.

**Installation (Fig. 5)**

**IMPORTANT: Any leaks in the air filter system will allow dirt into engine and will cause serious engine damage. Make sure that all air cleaner components are in good condition and are properly secured during assembly.**

1. Assemble all removed air cleaner components using Figure 5 as a guide.

   A. Install new gaskets (items 10 and 14) if they were removed.

   B. If flange head screws (item 9) were loosened or removed, torque screws from **60 to 65 in-lb (6.8 to 7.3 N-m)**.

   C. Make sure that air cleaner vacuator valve is pointed toward ground and slightly toward engine after assembly.

   D. Make sure to secure intake hoses with hose clamps.

2. Lower and secure cargo box.

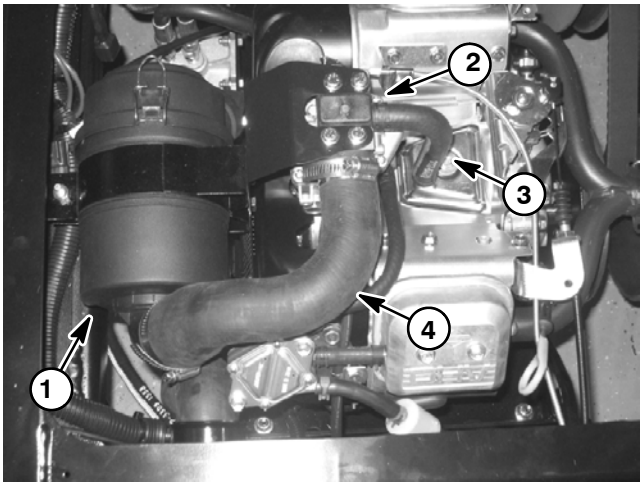


Figure 6

1. **Air cleaner**
2. **Carburetor adapter**
3. **Breather hose**
4. **Intake hose**

## Exhaust System

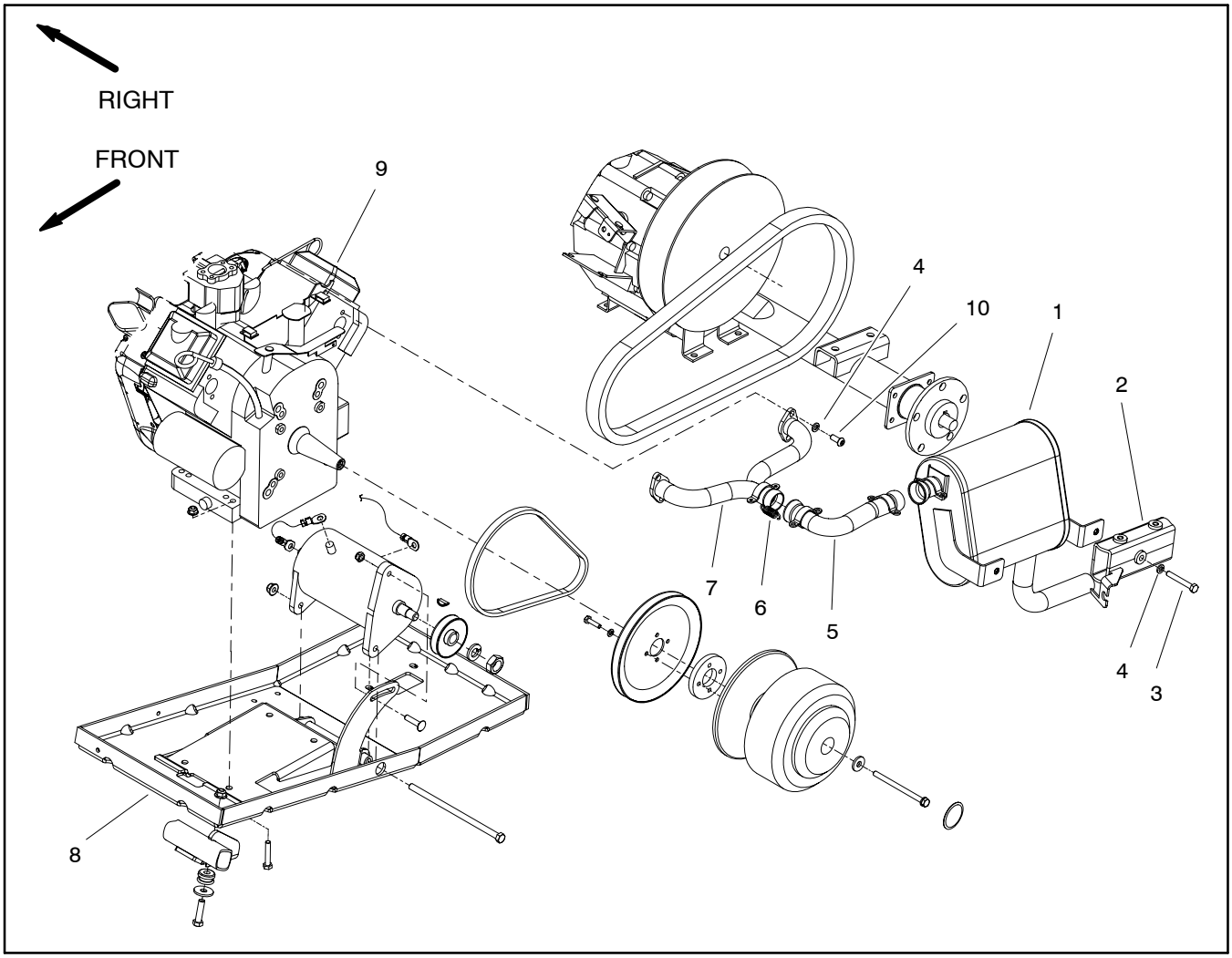


Figure 7

1. **Muffler**
2. **Swing arm**
3. **Cap screw (2 used)**
4. **Lock washer (6 used)**
5. **Exhaust coupler**
6. **Coupler spring (4 used)**
7. **Exhaust manifold**
8. **Engine tray**
9. **Engine**
10. **Screw (4 used)**

**Removal (Fig. 7)**

1. Park machine on a level surface, stop the engine, engage parking brake and remove the key from the ignition switch.

2. Raise cargo box and support with prop rod.

**CAUTION**

**The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working on the muffler.**

3. Remove four (4) coupler springs securing the exhaust coupler to the muffler and exhaust manifold. Remove exhaust coupler.

4. Remove two (2) cap screws and lock washers securing the muffler to the swing arm. Remove muffler from machine.

5. If exhaust manifold needs to be removed from engine, remove four (4) screws and lock washers securing the manifold to the engine. Remove exhaust manifold. Remove exhaust gaskets and clean gasket surfaces of manifold and engine.

**Installation (Fig. 7)**

**NOTE:** Mount all exhaust components loosely before tightening to ensure a proper fit of exhaust system.

1. If the exhaust manifold was removed from engine, install manifold to engine with new gaskets. Make sure that gaskets align with exhaust ports of cylinder heads. Loosely attach exhaust manifold to the engine with removed fasteners.

2. Position muffler to the machine. Secure muffler loosely to the swing arm with two (2) cap screws and lock washers.

3. Position exhaust coupler to the muffler and exhaust manifold. Secure coupler with four (4) coupler springs.

4. Tighten screws that secure exhaust manifold to the engine.

5. Tighten cap screws that secure muffler to the swing arm.

6. Lower and secure cargo box.

## Fuel Tank

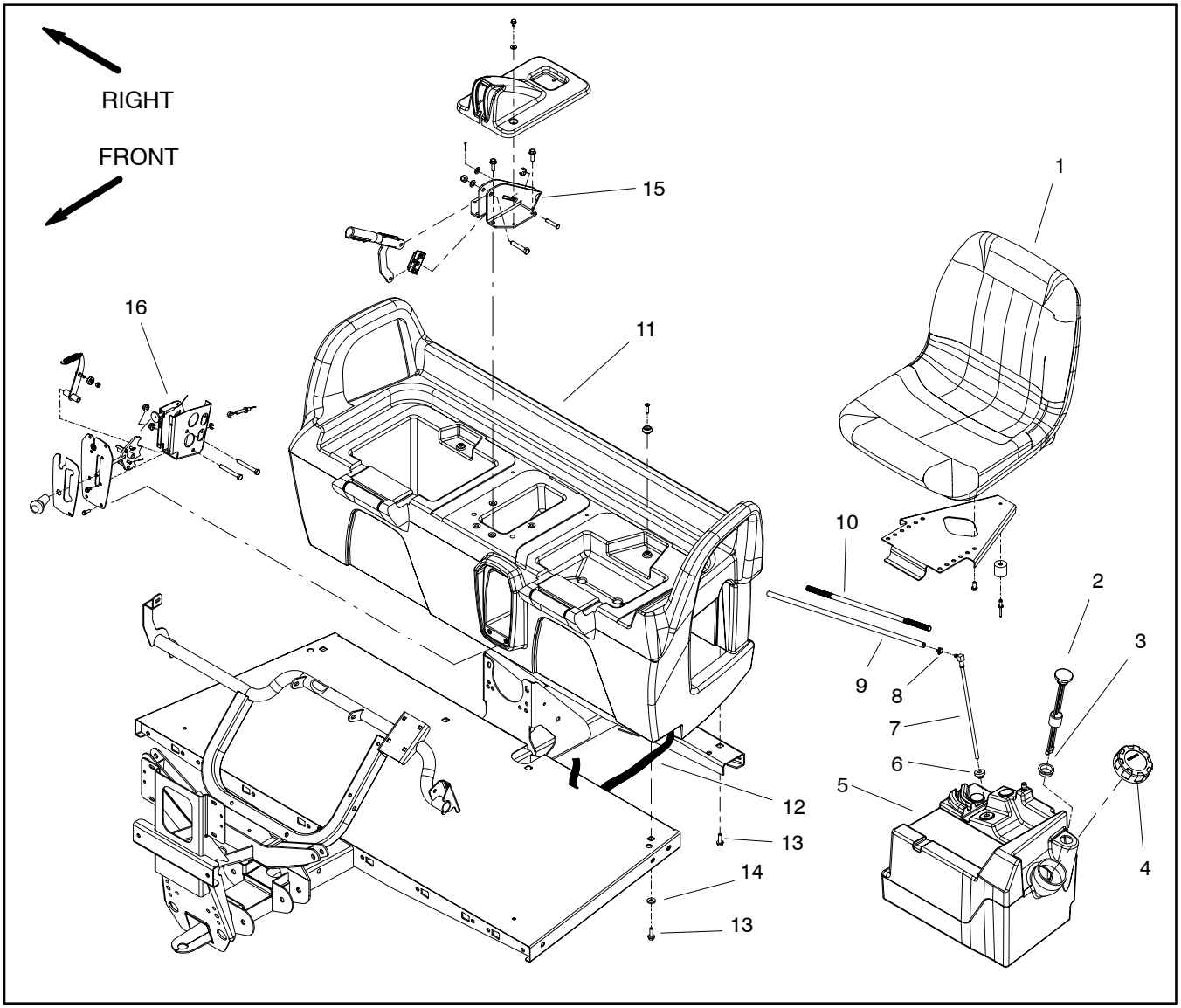


Figure 8

1. **Seat**
2. **Fuel gauge**
3. **Bushing**
4. **Gas cap**
5. **Fuel tank**
6. **Bushing**
7. **Stand pipe**
8. **Hose clamp**
9. **Fuel hose (to fuel filter)**
10. **Fuel line conduit**
11. **Seat base**
12. **Web strapping**
13. **Hex head flange screw (8 used)**
14. **Flat washer**
15. **Parking brake support**
16. **Shift bracket**

**Fuel Tank Removal (Fig. 10)**

**CAUTION**

**Read safety precautions for handling gasoline before working on the fuel system (see Safety Instructions in Chapter 1 - Safety).**

1. Remove seat base from the frame (see Seat Base Removal in the Service and Repairs section of Chapter 7 - Chassis).

2. Use fuel transfer pump to remove gas from fuel tank.

3. Loosen hose clamp and disconnect fuel hose from the fuel tank stand pipe.

4. Release tank strap that secures fuel tank to frame. Do not remove strap from floor plate and frame cross member. Lift tank from frame.

**NOTE:** Workman MDX vehicles with serial number above 310000000 are equipped with a fuel evaporative control system (EVAP) designed to collect and store evaporative emissions from the fuel tank. Fuel tank components for these vehicles are shown in Fig. 11.

5. If necessary, remove stand pipe, fuel gauge and bushings from tank.

**Fuel Tank Installation (Fig. 10)**

1. If removed, install bushings, stand pipe and fuel gauge to tank.

2. Position fuel tank to frame. Secure tank to frame and cross member with tank strap.

3. Connect fuel hose to the tank stand pipe and secure with hose clamp.

4. Install seat base to the frame (see Seat Base Installation in the Service and Repairs section of Chapter 7 - Chassis).

5. Fill fuel tank.

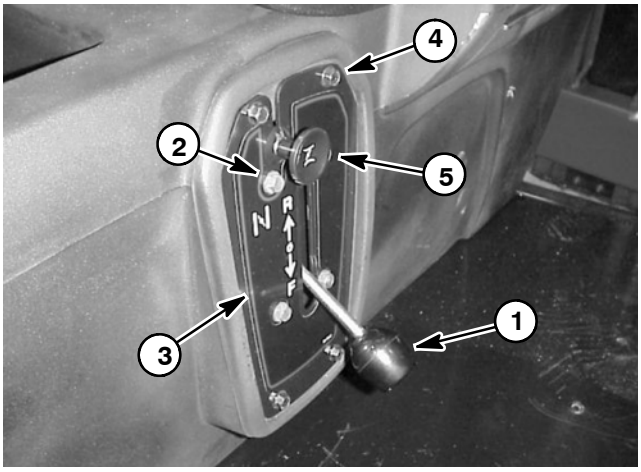


Figure 9

1. **Shift lever**
2. **Cap screw (short)**
3. **Shift plate**
4. **Cap screw (long)**
5. **Choke cable**

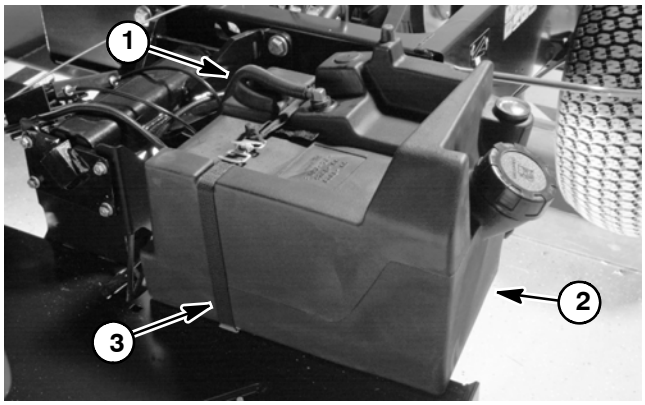


Figure 10

1. **Fuel hose**
2. **Fuel tank**
3. **Tank strap**

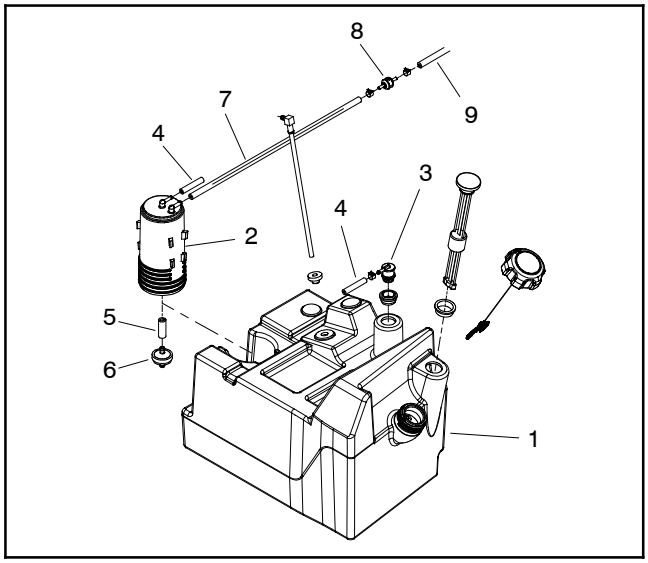


Figure 11

1. **Fuel tank**
2. **Carbon canister**
3. **Rollover valve**
4. **Fuel hose (tank vent)**
5. **Fuel hose**
6. **Fresh air filter**
7. **Fuel hose (purge hose)**
8. **Check valve**
9. **Fuel hose (to engine)**

## Oil Filter Assembly

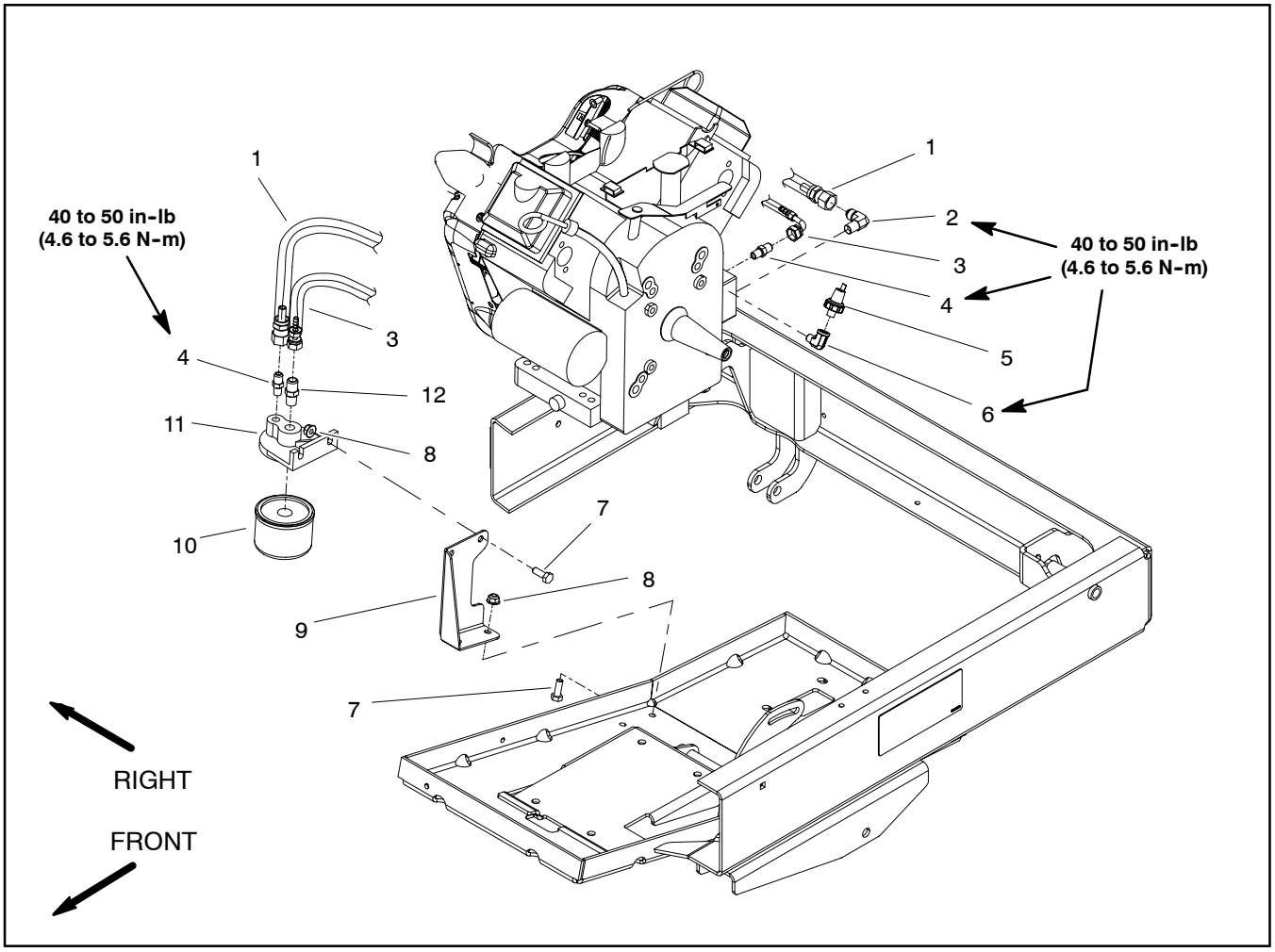


Figure 11

1. **Hose**
2. **Elbow fitting**
3. **Hose**
4. **Fitting**
5. **Oil pressure switch**
6. **Elbow fitting**
7. **Cap screw (4 used)**
8. **Flange nut (4 used)**
9. **Filter bracket**
10. **Oil filter**
11. **Oil filter adapter**
12. **Fitting**

**Removal (Fig. 11)**

1. Park machine on a level surface, stop the engine, engage parking brake and remove the key from the ignition switch.

2. Raise cargo box and support with prop rod.

3. To prevent contamination of engine lubrication system during adapter removal, thoroughly clean exterior of filter adapter, hoses and fittings.

4. Remove oil filter adapter components as needed using Figure 11 as a guide.

**Installation (Fig. 11)**

1. Install removed oil filter adapter components using Figure 11 as a guide. Torque fittings (items 2, 4 and 6) from **40 to 50 in-lb (4.6 to 5.6 N-m)**.

2. Check and adjust engine oil level.

3. Lower and secure cargo box.

## Engine

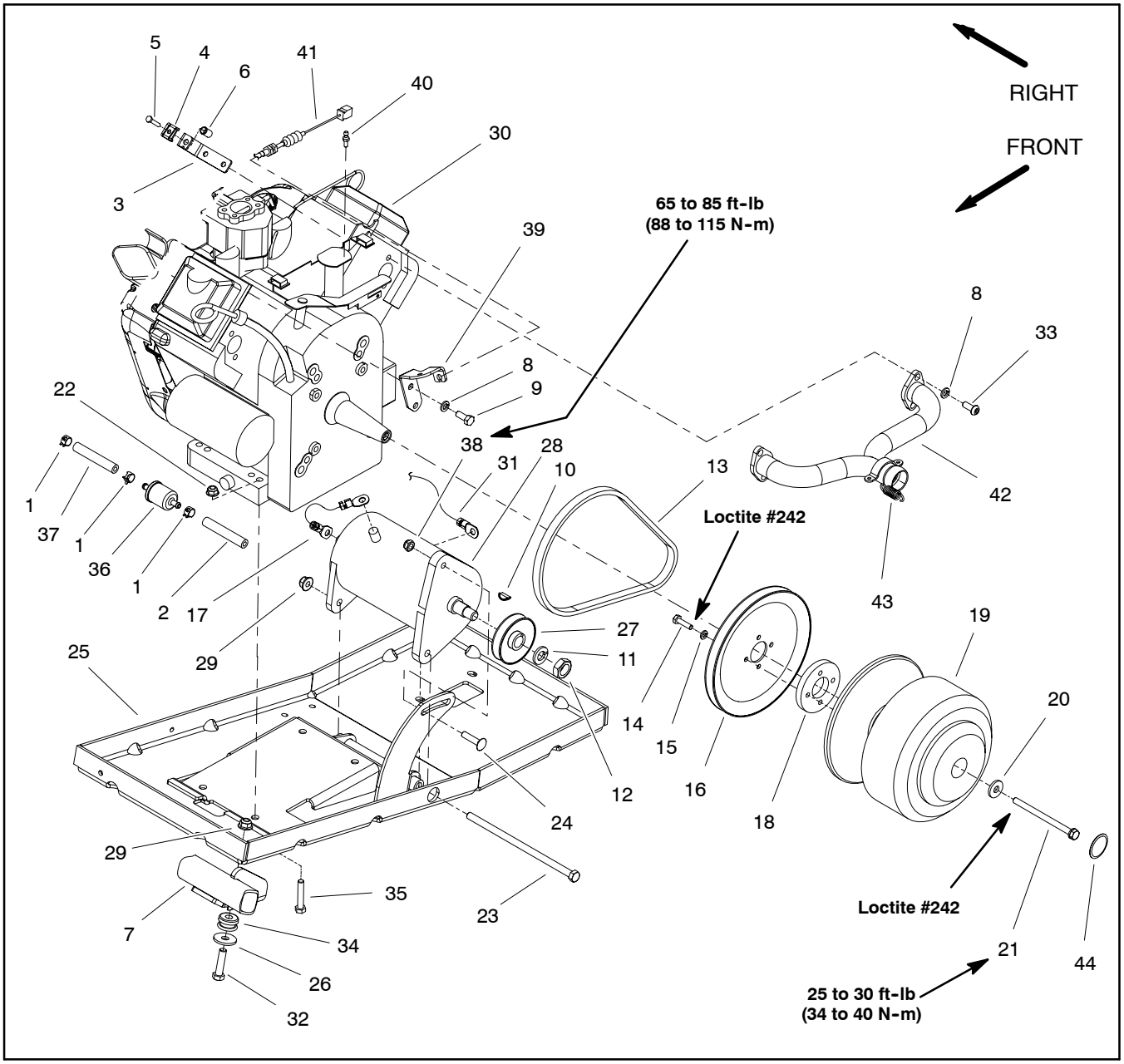


Figure 12

1. Hose clamp
2. Fuel hose (from tank)
3. Cable bracket
4. Cable clamp
5. Cap screw
6. Threaded insert
7. Swing arm
8. Lock washer (6 used)
9. Cap screw (2 used)
10. Woodruff key
11. Lock washer
12. Nut
13. Starter V-belt
14. Cap screw (4 used)
15. Lock washer (4 used)
16. Engine pulley
17. Negative cable
18. Starter spacer
19. Drive clutch
20. Washer
21. Cap screw
22. Flange nut (4 used)
23. Cap screw
24. Carriage screw
25. Engine tray
26. Washer (2 used)
27. Starter/generator pulley
28. Starter/generator
29. Flange nut (3 used)
30. Engine
31. Engine wire harness
32. Cap screw (2 used)
33. Screw (4 used)
34. Mount (2 used)
35. Cap screw (4 used)
36. Fuel filter
37. Fuel hose
38. Lock nut
39. Cable bracket
40. Ball stud
41. Cable
42. Exhaust manifold
43. Coupler spring (4 used)
44. Plastic cap

**Engine Removal (Fig. 12)**

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect negative (black) cable from the battery. Then, disconnect positive (red) cable from the battery.

3. Remove cargo box to gain access to the engine (see Cargo Box and Tailgate Removal in the Service and Repairs section of Chapter 7 – Chassis).

4. Depending on needed engine repairs, it may be easier to drain engine oil from engine before engine removal.

**IMPORTANT: To prevent contaminants from entering the engine and fuel system, make sure all hoses and engine openings are covered or plugged after disconnecting.**

5. Disconnect the following components (Fig. 13):

   A. Choke and throttle cables from the carburetor and cable brackets.

   B. Air intake hose from the air cleaner intake and machine frame.

**CAUTION**

**Read safety precautions for handling gasoline before working on the fuel system (see Safety Instructions in Chapter 1 - Safety).**

6. Disconnect fuel inlet hose from the fuel pump (Fig. 13).

7. Remove muffler and exhaust coupler from the machine (see Exhaust System Removal in this section).

8. Remove drive belt from drive clutch.

9. Loosen fasteners that secure starter/generator. Rotate starter/generator to loosen tension on starter belt and remove belt from the engine and starter/generator pulleys.

10. Remove two (2) cap screws and flange nuts that secure oil filter adapter to filter bracket (Fig. 16). Carefully place filter and adapter to allow them to be removed with engine.

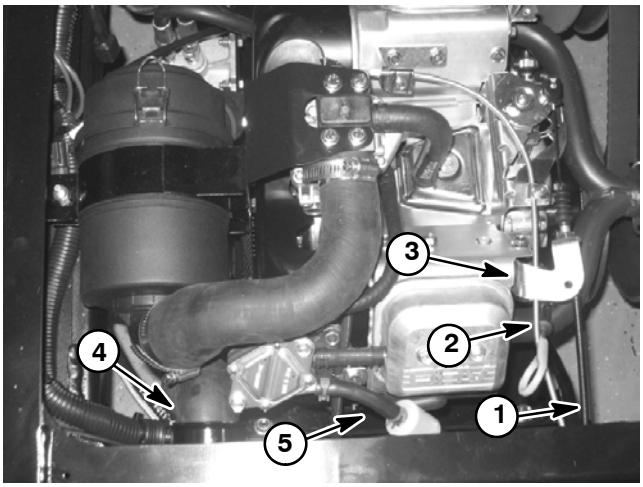


Figure 13

1. **Throttle cable**
2. **Choke cable**
3. **Cable bracket**
4. **Air intake hose**
5. **Fuel inlet hose**

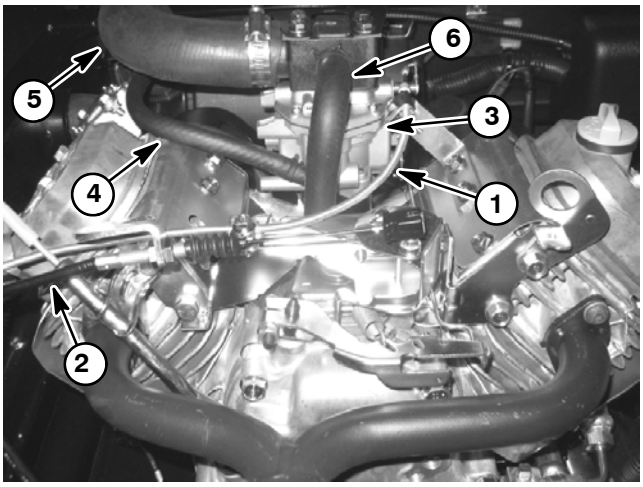


Figure 14

1. **Choke cable**
2. **Throttle cable**
3. **Carburetor**
4. **Fuel hose**
5. **Air intake hose**
6. **Breather hose**

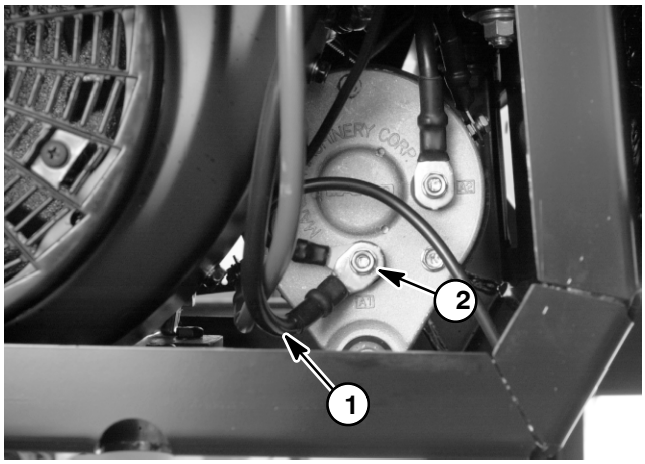


Figure 15

1. **Starter/Generator ground cable to engine**
2. **Starter/Generator terminal (A1)**

11. Disconnect electrical connections from the following engine components:

A. Disconnect ground cable to engine at starter/generator terminal A1 (Fig. 15).

B. Disconnect engine harness connector from the main harness.

12. Remove four (4) flange nuts and cap screws securing the engine to the engine tray.

**CAUTION**

**One person should operate the hoist while the other person guides the engine out of the frame.**

13. Remove engine from the engine tray.

A. Attach a short section of chain between both engine lift tabs.

B. Connect hoist to center of chain.

**IMPORTANT: Make sure to not damage the engine, fuel hoses, electrical harness or other parts while removing the engine.**

C. Slowly remove engine from the machine.

14. Remove engine parts and attachments as necessary to repair the engine.

**Engine Installation (Fig. 12)**

1. Install all removed parts and attachments to the engine.

**CAUTION**

**One person should operate the hoist while the other person guides the engine into the frame.**

2. Install engine to the engine tray.

A. Attach a short section of chain between both engine lift tabs.

B. Connect a hoist at the center of the short section of chain.

**IMPORTANT: Make sure to not damage engine, fuel lines, electrical harness or other parts while installing the engine.**

C. Carefully lower engine onto the engine tray.

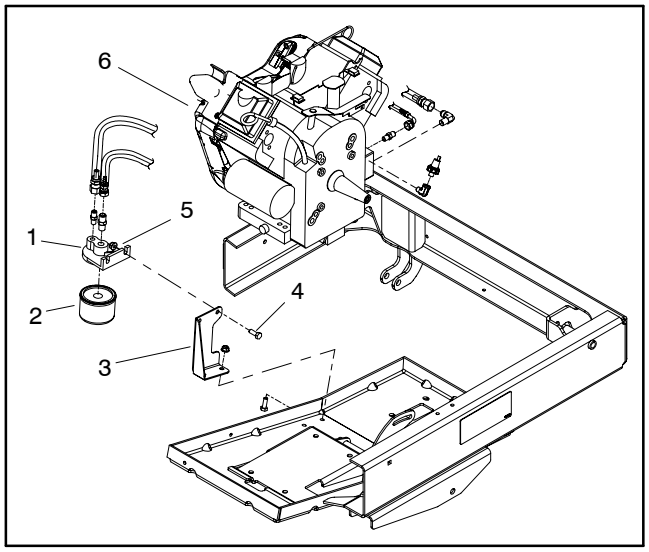


Figure 16

1. **Oil filter adapter**
2. **Oil filter**
3. **Filter bracket**
4. **Cap screw**
5. **Flange nut**
6. **Engine**

3. Install four (4) cap screws and flange nuts to engine and engine tray. Position engine on engine tray to align clutch drive pulley and driven pulley on transaxle. Tighten fasteners.

4. Carefully position oil filter assembly to filter bracket (Fig. 16). Secure filter adapter with two (2) cap screws and flange nuts.

5. Connect the following electrical components:

A. Connect ground cable from the engine at starter/generator terminal A1 (Fig. 15).

B. Connect engine harness connector to the main harness connector.

6. Install starter belt to the engine and starter/generator pulleys. Tension the belt by rotating the starter/generator away from the engine. Tighten fasteners to secure starter/generator.

7. Install drive belt to drive clutch.

**IMPORTANT: Make sure to remove all plugs and covers that were placed on hose and engine openings during engine removal.**

8. Install muffler and exhaust coupler to the machine (see Exhaust System Installation in this section).

9. Connect fuel inlet hose to the fuel pump (Fig. 13).

10. Connect the following components (Fig. 13):

    A. Choke and throttle cables to the carburetor and cable bracket.

    B. Air intake hose to the air cleaner intake and machine frame.

11. Install cargo box to the frame (see Cargo Box and Tailgate Installation in the Service and Repairs section of Chapter 7 – Chassis).

12. Connect positive (red) cable to the battery. Then, connect negative (black) cable to the battery.

13. Make sure engine oil level is correct.

## Fuel Evaporative Control System (Serial Number Above 310000000)

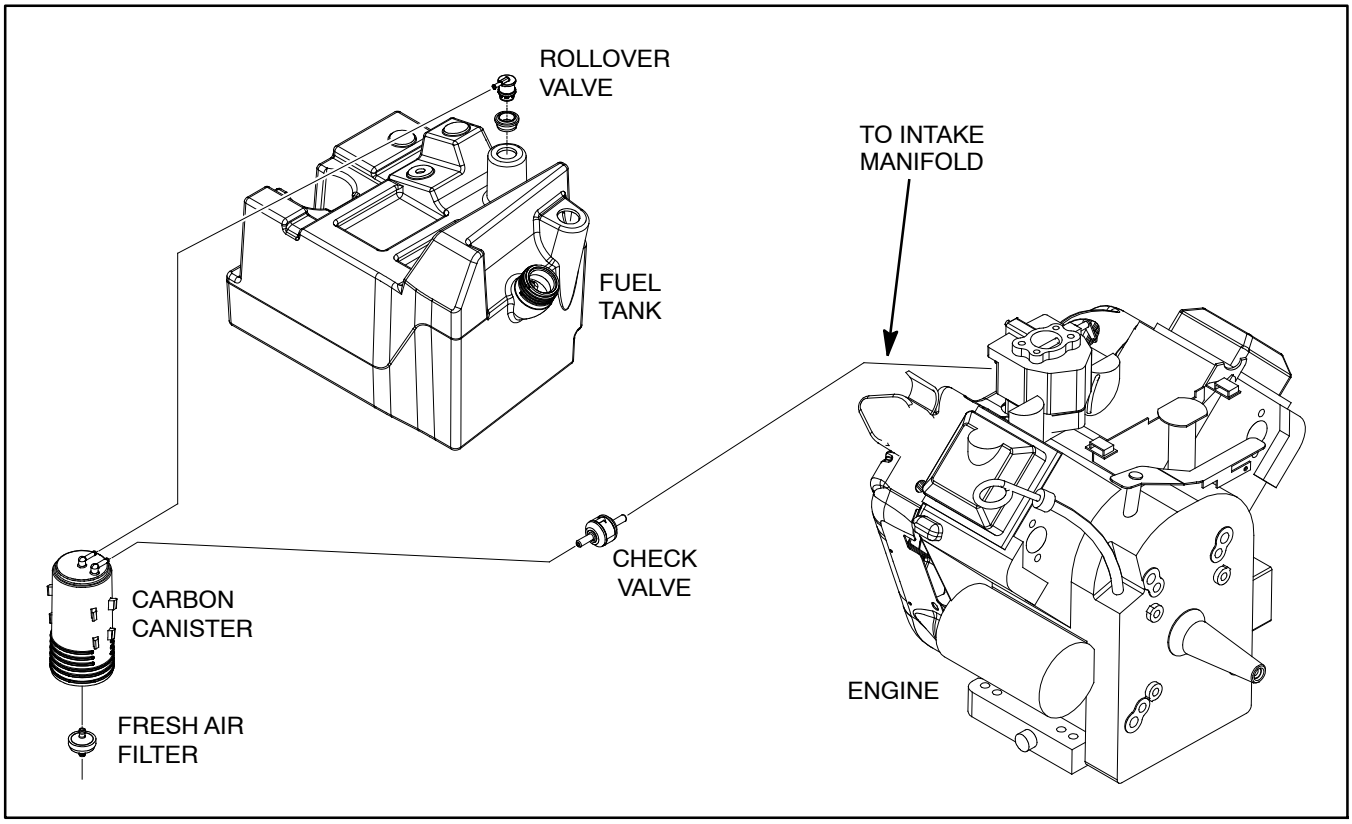


Figure 18

Workman MDX vehicles with serial number above 310000000 are equipped with a fuel evaporative control system (EVAP) designed to collect and store evaporative emissions from the fuel tank. The EVAP uses a carbon canister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister where they are stored. Vapors from the canister are consumed when the engine is running which purges the canister.

The fuel tank on these Workman vehicles uses a non–vented fuel cap. To connect the tank to the evaporative control system, a rollover valve is positioned in the top of the tank that allows tank venting through the carbon canister.

**NOTE:** If there is restriction in the fresh air filter, the carbon canister or the rollover valve, the fuel tank may distort due to venting issues. If the fuel tank returns to it's normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

Machines with a carbon canister include a single engine connection to the engine intake system that is used to connect the evaporative system to the engine. These machines use an inline check valve between the carbon canister and the engine fitting. Evaporative control system components for Workman MDX vehicles are shown in Figure 19.

**Disassembly (Fig. 19)**

**DANGER**

**Gasoline is flammable. Use caution when storing or handling it. Wipe up any spilled fuel before starting the engine.**

1. Inspect carbon cannister and attached hoses for damage or obvious leaks. A damaged or leaking cannister should be replaced.

2. Remove components as needed using Figure 19 as a guide.

A. If check valve (item 8 in Fig. 19) is removed, note direction of directional arrow on valve body for assembly purposes (Fig. 20).

B. If carbon canister is to be removed, note hose positions on the canister for assembly purposes (Fig. 21).

C. Note location of hose clamps for assembly purposes.

**Assembly**

1. Install all removed components using Figure 19 as a guide.

A. If check valve (item 7 in Fig. 19) was removed, make sure that directional arrow on valve body points toward engine (Fig. 20).

B. Make sure that fuel hoses are not kinked after installation. Also, secure hoses with hose clamps.

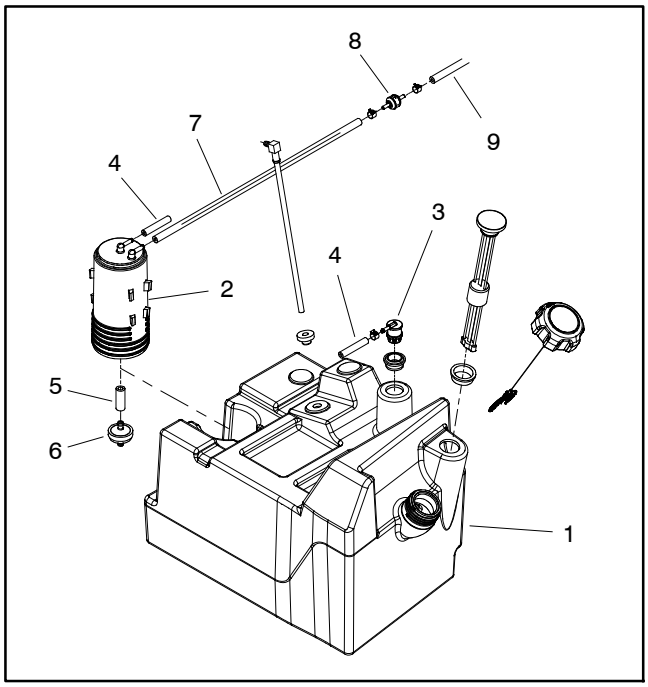


Figure 19

1. **Fuel tank**
2. **Carbon canister**
3. **Rollover valve**
4. **Fuel hose (tank vent)**
5. **Fuel hose**
6. **Fresh air filter**
7. **Fuel hose (purge hose)**
8. **Check valve**
9. **Fuel hose (to engine)**

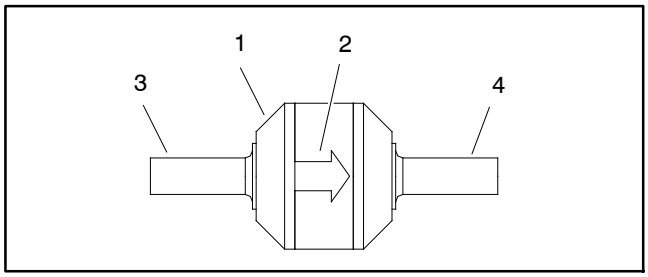


Figure 20

1. **Check valve**
2. **Directional arrow**
3. **Fitting from canister**
4. **Fitting to engine**

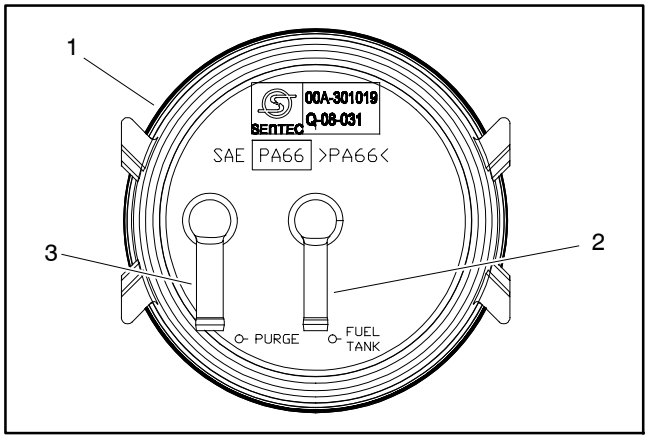


Figure 21

1. **Top of carbon canister**
2. **Fitting to rollover valve**
3. **Fitting to engine**

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Chapter 4

# Single Cylinder Gasoline Engine

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KOHLER SERVICE MANUAL FOR COMMAND PRO CS SERIES ENGINES

# General Information

This Chapter gives information about specifications, maintenance, troubleshooting, testing and repair of the single cylinder gasoline engine used in the Workman MD.

Workman MD vehicles with serial numbers below 311000000 have an engine that is identified as a Kohler Command Pro CS engine. Workman MD vehicles with serial numbers above 311000000 have an engine that is identified as a Yamaha MZ360 engine. From a service standpoint, these engines are essentially the same. The Kohler Service Manual for COMMAND PRO CS Series Engines is included at the end of this chapter and can be used when servicing either brand of engine.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kohler Service Manual for COMMAND PRO CS Series Engines and the use of some specialized test equipment is explained. The cost of the test equipment and the specialized nature of some repairs may dictate that engine work be done at an engine repair facility.

Service and repair parts for the engine used in the Workman MD can be provided by your local Toro distributor.

## Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman MD vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

# Specifications

| Item | Description |
|---|---|
| Make / Designation | 4-cycle, Single Cylinder, OHV, Air Cooled, Gasoline Engine |
| Bore x Stroke | 3.35 in x 2.48 in (85 mm x 63 mm) |
| Total Displacement | 21.8 $in^3$ (357 cc) |
| Governor | Transaxle, Ground Speed Governing |
| Carburetor | Float Feed, Single Barrel |
| Fuel Pump | Pulsating Crankcase Vacuum |
| Fuel | Unleaded regular grade gasoline |
| Fuel Tank Capacity | 7.0 U.S. gal (26.5 l) |
| Lubrication System | Splash Lubrication |
| Crankcase Oil Capacity | 1.2 U.S. qt (1.1 l) |
| Engine Oil | See Operator's Manual |
| Spark Plugs | Champion RC 14YC (or equivalent) |
| Spark Plug Gap | 0.030 in (0.76 mm) |
| Starter/Generator | 10.5 VDC 100 Amps/14 VDC and 23 Amps |
| Dry Weight (approximate) | 70.5 lb (31.9 kg) |

# Adjustments

## Adjust Throttle Cable (Serial Numbers Below 313000400)

**NOTE:** Workman MD vehicles with serial numbers below 313000400 use a governor in the transaxle to control engine speed.

Releasing the accelerator pedal should allow the throttle cable to close the carburetor throttle control lever so that the lever touches the adjustment screw. The adjustment screw keeps the throttle valve inside the carburetor open slightly to prevent the valve from binding.

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Lift cargo box and prop with rod to gain access to the engine and transaxle.

3. Rotate governor arm on transaxle fully clockwise (Fig. 1).

4. Make sure of the following:

   A. The carburetor throttle lever should be to the fully open position without contacting the stop (Fig. 2).

   B. Adjust governor cable at the transaxle cable bracket as necessary, so there is no compression of the cable (Fig. 1). This will allow the throttle lever to fully close when the accelerator pedal is released.

5. Release the governor arm on transaxle and make sure that the carburetor throttle lever fully closes.

6. After throttle cable adjustment is correct, lower and secure cargo box.

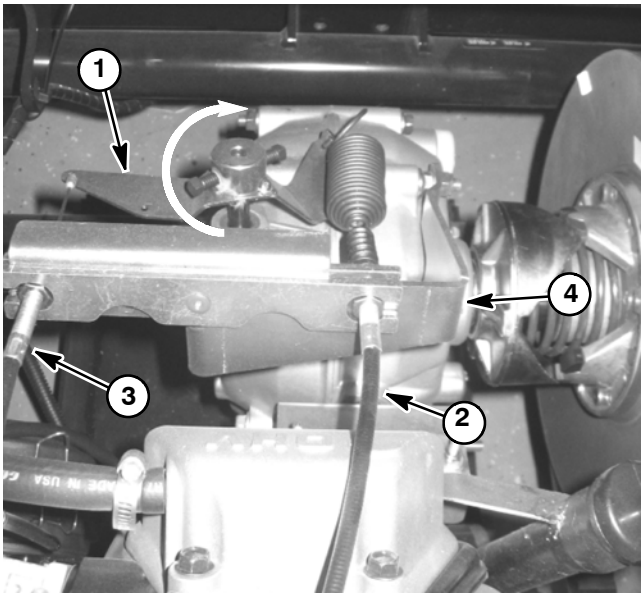


Figure 1

1. **Governor arm**
2. **Throttle cable**
3. **Governor cable**
4. **Cable bracket**

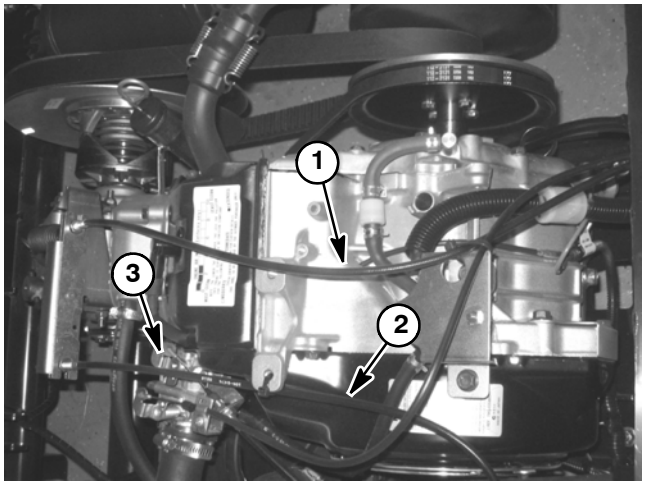


Figure 2

1. **Throttle cable**
2. **Governor cable**
3. **Carb throttle lever**

## Adjust Throttle Cable (Serial Numbers Above 313000400)

**NOTE:** Workman MD vehicles with serial numbers above 313000400 use the engine governor to control engine speed. Refer to the Kohler Service Manual at the end of this chapter for governor information on these machines.

Depressing the accelerator pedal rotates the engine mounted throttle lever which tensions the engine governor spring to increase engine speed. Releasing the accelerator pedal decreases governor spring tension to reduce engine speed.

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Lift cargo box and prop with rod to gain access to the engine (Fig. 3).

3. Make sure that shift lever is in the neutral position to prevent the machine from moving.

**NOTE:** If phototac is to be used to measure engine speed, DO NOT use driven clutch on transaxle for speed measurement.

4. With ignition switch in the RUN position, depress accelerator pedal and allow engine to start. Fully depress accelerator pedal and have a second person measure engine speed with a tachometer. With pedal fully depressed, engine speed should be from **3250 to 3350 RPM**. If necessary, adjust jam nuts on throttle cable so that engine speed is correct when the accelerator pedal is fully depressed.

5. After throttle cable adjustment is correct, lower and secure cargo box.

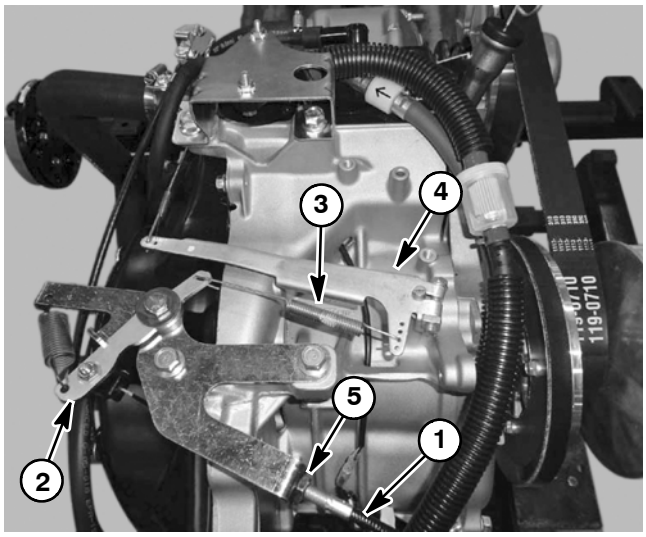


Figure 3

1. **Throttle cable**
2. **Throttle lever**
3. **Engine governor spring**
4. **Engine governor lever**
5. **Cable jam nut**

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## Cooling System

To ensure proper engine cooling, make sure the grass screen, cooling fins and other external surfaces of the engine are kept clean at all times.

**NOTE:** Perform this maintenance procedure at the interval specified in the Operator's Manual.

**IMPORTANT: The engine that powers the Workman MD is air-cooled. Operating the engine with dirty or plugged cooling fins or a plugged or dirty blower housing will result in engine overheating and damage.**

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Raise bed and support with prop rod.

3. Carefully remove spark plug wire from the spark plug to prevent the engine from starting unexpectedly.

**IMPORTANT: Never clean engine with pressurized water. Water could enter and contaminate the fuel system.**

4. Clean cooling fins on cylinder head.

5. Clean static debris screen and blower housing of dirt and debris. Remove screen and housing if necessary (Fig. 4).

**IMPORTANT: Never operate engine without the blower housing installed. Overheating and engine damage will result.**

6. Make sure static screen and blower housing are reinstalled to the engine if removed.

7. Attach spark plug wire to spark plug.

8. Lower and secure bed.

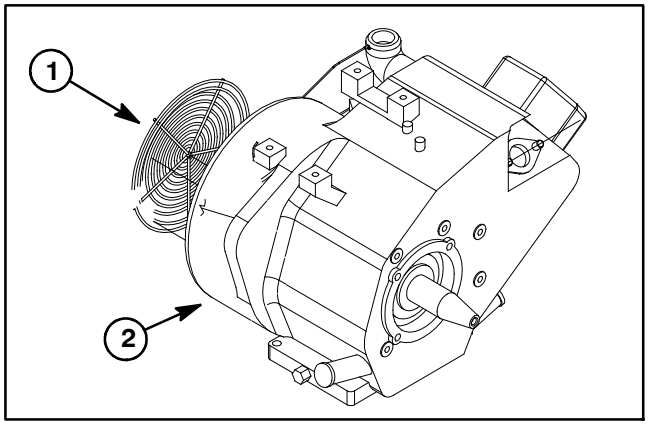


Figure 4

1. Static debris screen
2. Blower housing

## Exhaust System

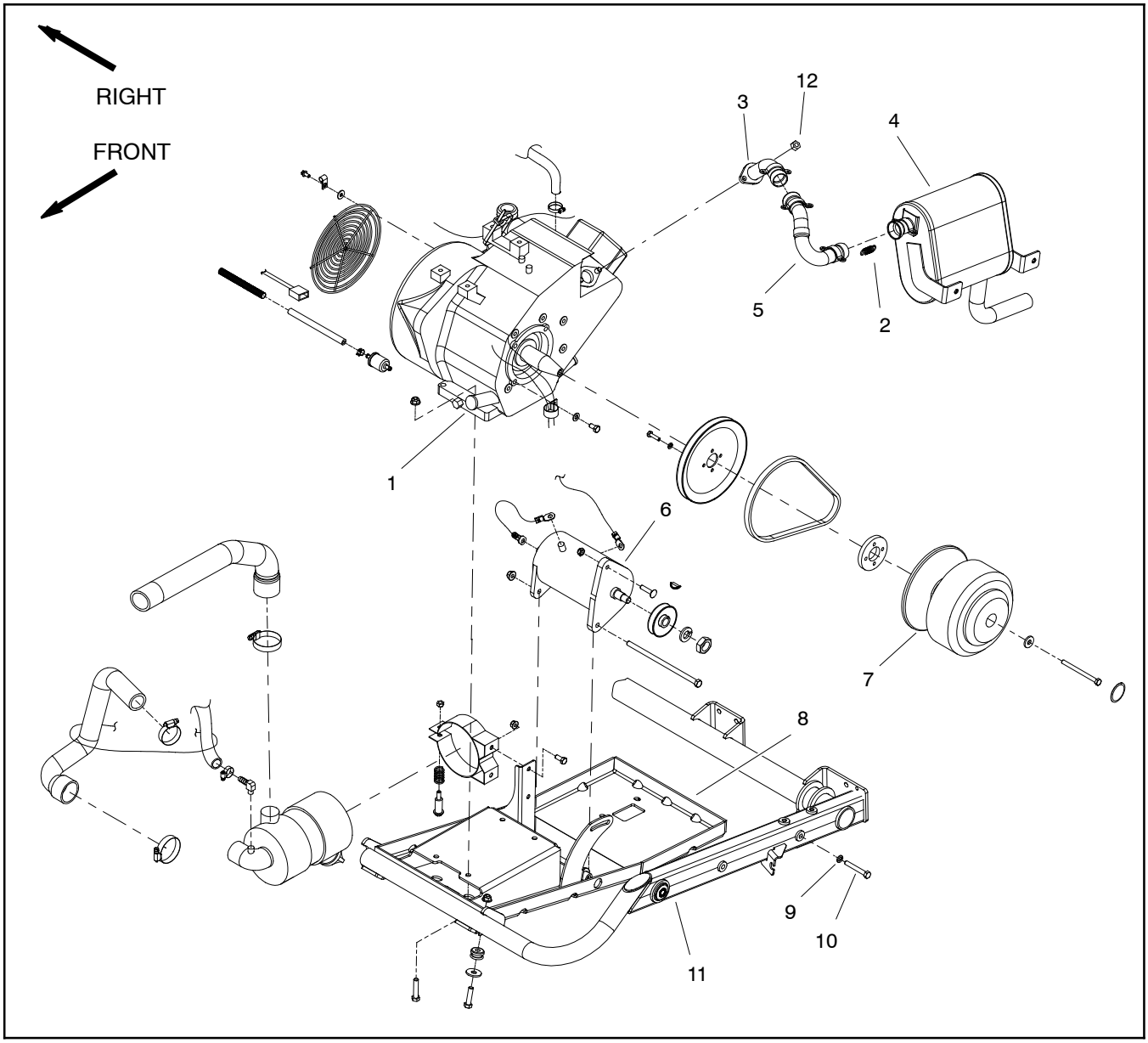


Figure 5

1. **Engine**
2. **Coupler spring (4 used)**
3. **Exhaust manifold**
4. **Muffler**
5. **Exhaust coupler**
6. **Starter/generator**
7. **Drive clutch**
8. **Engine tray**
9. **Lock washer (2 used)**
10. **Cap screw (2 used)**
11. **Swing arm**
12. **Nut (2 used)**

**Removal (Fig. 5)**

1. Park machine on a level surface, stop the engine, engage parking brake and remove the key from the ignition switch.

2. Raise cargo box and support with prop rod.

**CAUTION**

**The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working on the muffler.**

3. Remove four (4) springs securing the exhaust coupler to the muffler and exhaust manifold (Fig. 6).

4. Remove two (2) cap screws and lock washers securing the muffler to the swing arm.

5. Remove exhaust coupler and muffler.

6. If needed, remove exhaust manifold from engine by removing two (2) nuts. Remove exhaust gasket and clean gasket surfaces of manifold and engine.

**Installation (Fig. 5)**

**NOTE:** Mount all exhaust components loosely before tightening to ensure a proper fit of exhaust system.

1. If the exhaust manifold was removed from engine, install manifold to engine with new gasket. Attach exhaust manifold loosely to the engine with removed nuts.

2. Install muffler to the swing arm with two (2) cap screws and lock washers.

3. Insert exhaust coupler between muffler and manifold. Install springs to attach exhaust coupler to the exhaust manifold and muffler.

4. Tighten all exhaust system fasteners.

5. Lower and secure cargo box.

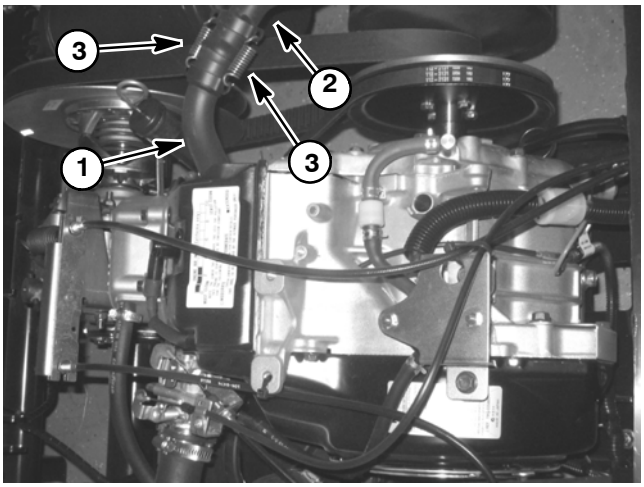


Figure 6

1. **Exhaust manifold**
2. **Exhaust coupler**
3. **Spring**

## Fuel Tank

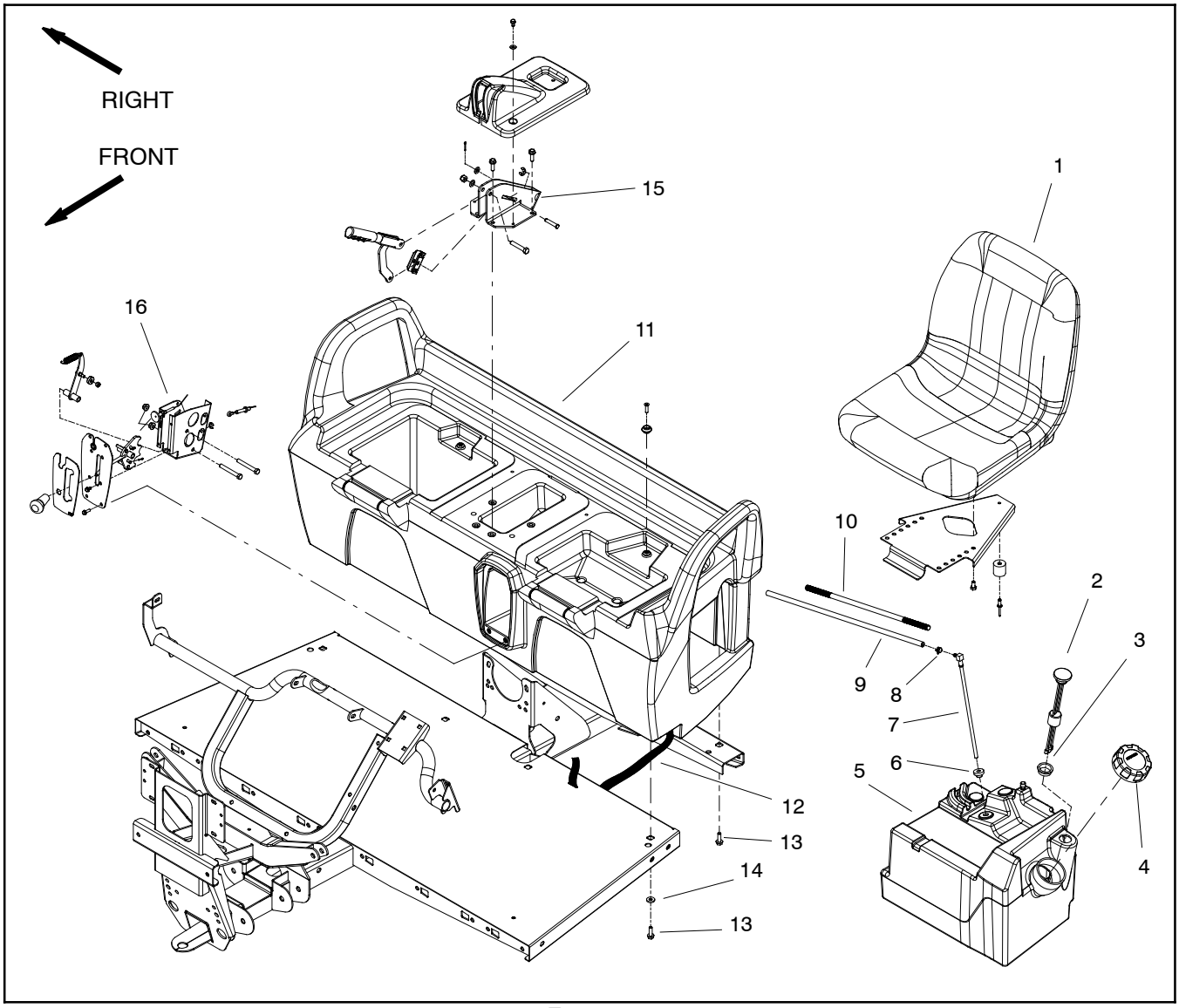


Figure 7

1. **Seat**
2. **Fuel gauge**
3. **Bushing**
4. **Gas cap**
5. **Fuel tank**
6. **Bushing**
7. **Stand pipe**
8. **Hose clamp**
9. **Fuel hose (to fuel filter)**
10. **Fuel line conduit**
11. **Seat base**
12. **Web strapping**
13. **Hex head flange screw (8 used)**
14. **Flat washer**
15. **Parking brake support**
16. **Shift bracket**

**Fuel Tank Removal (Fig. 7)**

**CAUTION**

**Read safety precautions for handling gasoline before working on the fuel system (see Safety Instructions in Chapter 1 – Safety).**

1. Remove seat base from the frame (see Seat Base Removal in the Service and Repairs section of Chapter 7 – Chassis).

2. Use fuel transfer pump to remove gas from fuel tank.

3. Loosen hose clamp and disconnect fuel hose from the fuel tank stand pipe.

4. Release tank web strapping from fuel tank. Do not remove strapping from floor plate and frame cross member. Lift tank from frame.

**NOTE:** Workman MD vehicles with serial number above 310000000 are equipped with a fuel evaporative control system (EVAP) designed to collect and store evaporative emissions from the fuel tank. Fuel tank components for these vehicles are shown in Fig. 10.

5. If necessary, remove stand pipe, fuel gauge and bushings from tank.

**Fuel Tank Installation (Fig. 7)**

1. If removed, install bushings, stand pipe and fuel gauge to tank.

2. Position fuel tank to frame. Secure tank to frame and cross member with tank web strapping.

3. Connect fuel hose to the tank stand pipe and secure with hose clamp.

4. Install seat base to the frame (see Seat Base Installation in the Service and Repairs section of Chapter 7 – Chassis).

5. Fill fuel tank.

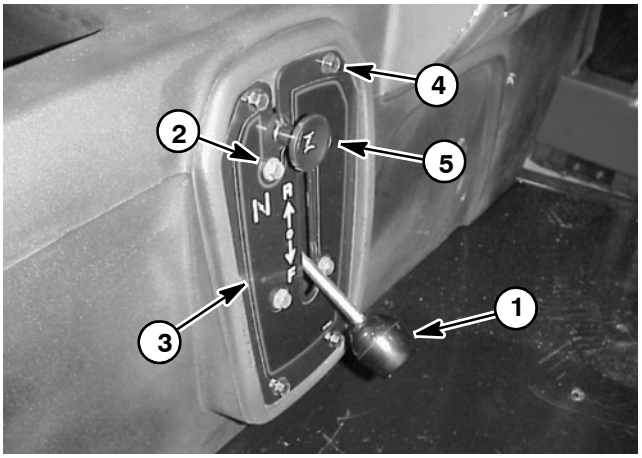


Figure 8

1. Shift lever
2. Cap screw (short)
3. Shift plate
4. Cap screw (long)
5. Choke cable

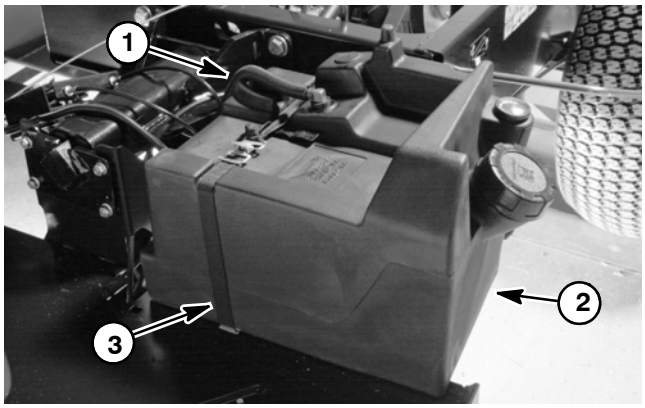


Figure 9

1. Fuel hose
2. Fuel tank
3. Tank web strapping

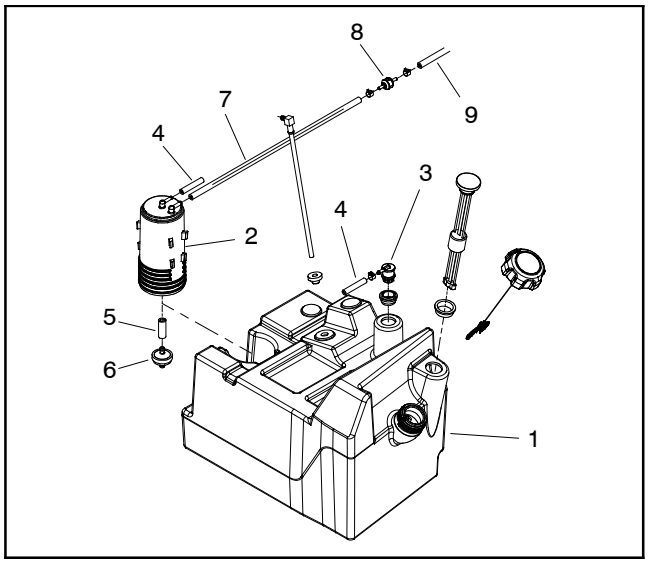


Figure 10

1. Fuel tank
2. Carbon canister
3. Rollover valve
4. Fuel hose (tank vent)
5. Fuel hose
6. Fresh air filter
7. Fuel hose (purge hose)
8. Check valve
9. Fuel hose (to engine)

## Engine

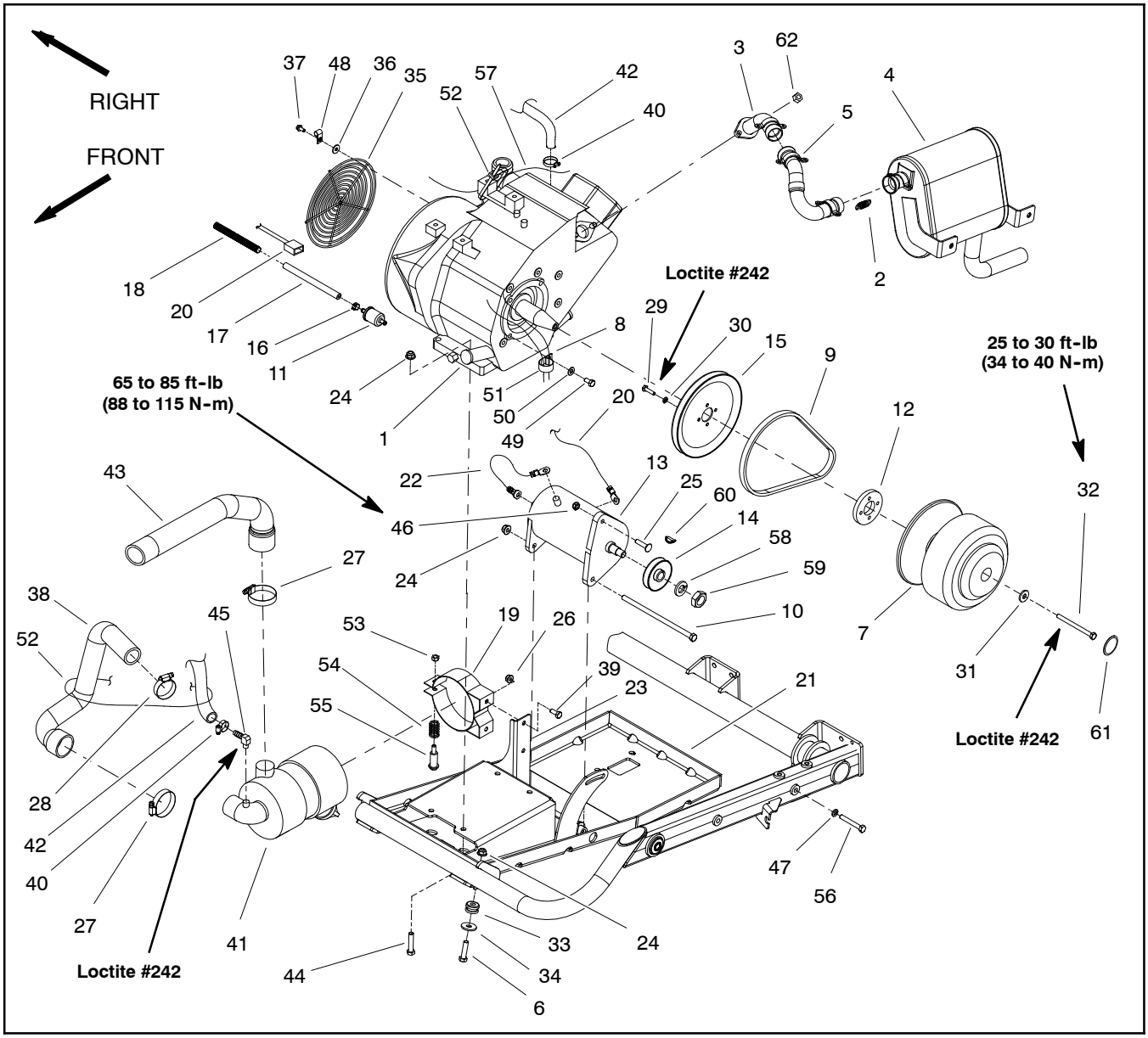


Figure 11

1. Kohler engine
2. Coupler spring (4 used)
3. Exhaust manifold
4. Muffler
5. Exhaust coupler
6. Cap screw (2 used)
7. Drive clutch
8. Shift cable (2 used)
9. Starter belt
10. Cap screw
11. Fuel filter
12. Engine pulley spacer
13. Starter/generator
14. Starter pulley
15. Engine pulley
16. Hose clamp (3 used)
17. Fuel hose
18. Fuel hose conduit
19. Air filter mounting band
20. Engine wire harness
21. Engine tray
22. Negative cable
23. Air cleaner bracket
24. Flange nut (7 used)
25. Carriage screw
26. Flange nut (2 used)
27. Hose clamp (2 used)
28. Hose clamp
29. Cap screw (4 used)
30. Lock washer (4 used)
31. Washer
32. Cap screw
33. Mount (2 used)
34. Washer (2 used)
35. Flywheel guard
36. Flat washer (4 used)
37. Flange head screw (4 used)
38. Intake hose
39. Cap screw (2 used)
40. Hose clamp (2 used)
41. Air cleaner assembly
42. Breather hose
43. Intake hose
44. Cap screw (4 used)
45. Fitting
46. Lock nut
47. Lock washer (2 used)
48. R-clamp
49. Cap screw
50. Flat washer
51. R-clamp
52. Cable tie (2 used)
53. Nut
54. Spring
55. Bolt
56. Cap screw (2 used)
57. Governor cable
58. Lock washer
59. Nut
60. Woodruff key
61. Plastic cap
62. Nut (2 used)

**Engine Removal (Fig. 11)**

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect ground (black) cable from the battery. Then, disconnect positive (red) cable from the battery.

3. Remove cargo box to gain access to the engine (see Cargo Box and Tailgate Removal in the Service and Repairs section of Chapter 7 – Chassis).

**IMPORTANT: Make sure all hoses and engine openings are plugged after disconnecting. This will prevent contaminants from entering the engine and fuel system.**

4. Disconnect the following components:

   A. Choke and governor cables from the carburetor and cable bracket.

   B. Air intake hose (item 38) from the carburetor.

   C. Breather hose (item 42) from the engine valve cover.

**CAUTION**

**Read safety precautions for handling gasoline before working on the fuel system (see Safety Instructions in Chapter 1 – Safety).**

5. Disconnect fuel hose from the fuel pump (Fig. 12). Remove cable tie securing the choke and throttle cables to the fuel pump bracket.

6. Remove muffler and exhaust coupler (see Muffler Removal in this section).

7. Remove drive belt from drive clutch.

8. Loosen fasteners that secure starter/generator. Rotate starter/generator toward engine to loosen tension on starter belt. Remove belt from the engine and starter/generator pulleys.

9. Remove cap screw (item 49) and flat washer (item 50) that secure r–clamp (item 51) and shift cables (item 8) to engine. Position shift cables away from engine.

10. Disconnect engine electrical harness connector from the main harness.

11. Remove four (4) flange nuts and cap screws securing the engine to the engine tray.

**CAUTION**

**One person should operate the hoist while a second person guides the engine out of the frame.**

12. Remove engine from the engine tray.

   A. Attach a short section of chain between fuel pump bracket lift hole and exhaust manifold (Fig. 12).

   B. Connect hoist to center of chain.

   **IMPORTANT: Make sure to not damage the engine, fuel hoses, electrical harness or other parts while removing the engine.**

   C. Slowly raise engine and attachments from the machine.

13. Remove engine parts and attachments as necessary to repair the engine.

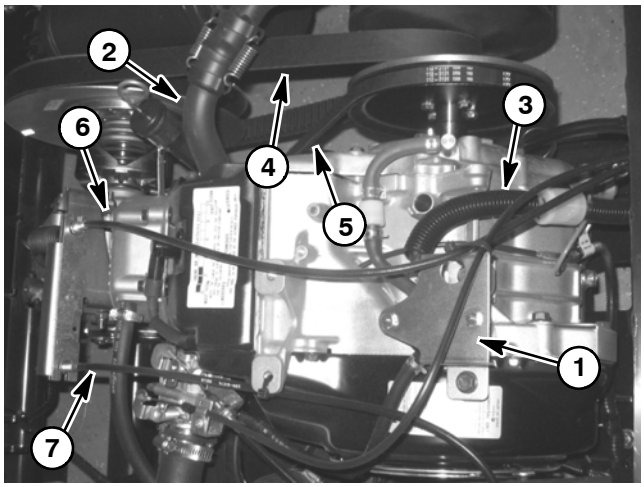


Figure 12

1. Fuel pump bracket
2. Exhaust manifold
3. Fuel line
4. Drive belt
5. Starter/generator belt
6. Throttle cable
7. Governor cable

**Engine Installation (Fig. 11)**

1. Install all removed engine parts and attachments to the engine.

**CAUTION**

**One person should operate the hoist while a second person guides the engine into the frame.**

2. Install engine to the frame.

   A. Attach a short section of chain between fuel pump bracket lift hole and exhaust manifold (Fig. 12).

   B. Connect a hoist at the center of the chain.

   **IMPORTANT: Make sure to not damage engine, fuel lines, electrical harness or other parts while installing the engine.**

   C. Lower engine onto the engine tray.

3. Install four (4) cap screws and flange nuts to engine and engine tray. Position engine on engine tray to align clutch drive pulley and driven pulley on transaxle. Tighten fasteners.

4. Connect engine harness connector to the main electrical harness.

5. Remove cap screw (item 49) and flat washer (item 50) that secure r−clamp (item 51) and shift cables (item 8) to engine. Position r−clamp (item 51) and shift cables (item 8) to engine. Secure r−clamp to engine with flat washer (item 50) and cap screw (item 49).

6. Install starter belt to the engine and starter/generator pulleys. Tension the belt by rotating the starter/generator away from the engine. Tighten fasteners to secure starter/generator.

7. Install drive belt to drive clutch.

**IMPORTANT: Make sure to remove all plugs and covers that were placed on hose and engine openings during engine removal.**

8. Install muffler and exhaust coupler to the exhaust manifold (see Muffler Installation in this section).

9. Connect fuel hose to the fuel pump (Fig. 12). Make sure to secure hose with hose clamp.

10. Connect the following components:

    A. Choke and throttle cables to the carburetor and cable bracket.

    B. Air intake hose to the carburetor.

    C. Breather hose to the engine valve cover.

11. Secure choke and throttle cables to the fuel pump bracket with cable tie.

12. Install cargo box to the frame (see Cargo Box and Tailgate Installation in the Service and Repairs section of Chapter 7 − Chassis).

13. Connect positive (red) cable to the battery. Then, connect ground (black) cable to the battery.

14. Make sure engine oil level is correct.

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## Fuel Evaporative Control System (Serial Number Above 310000000)

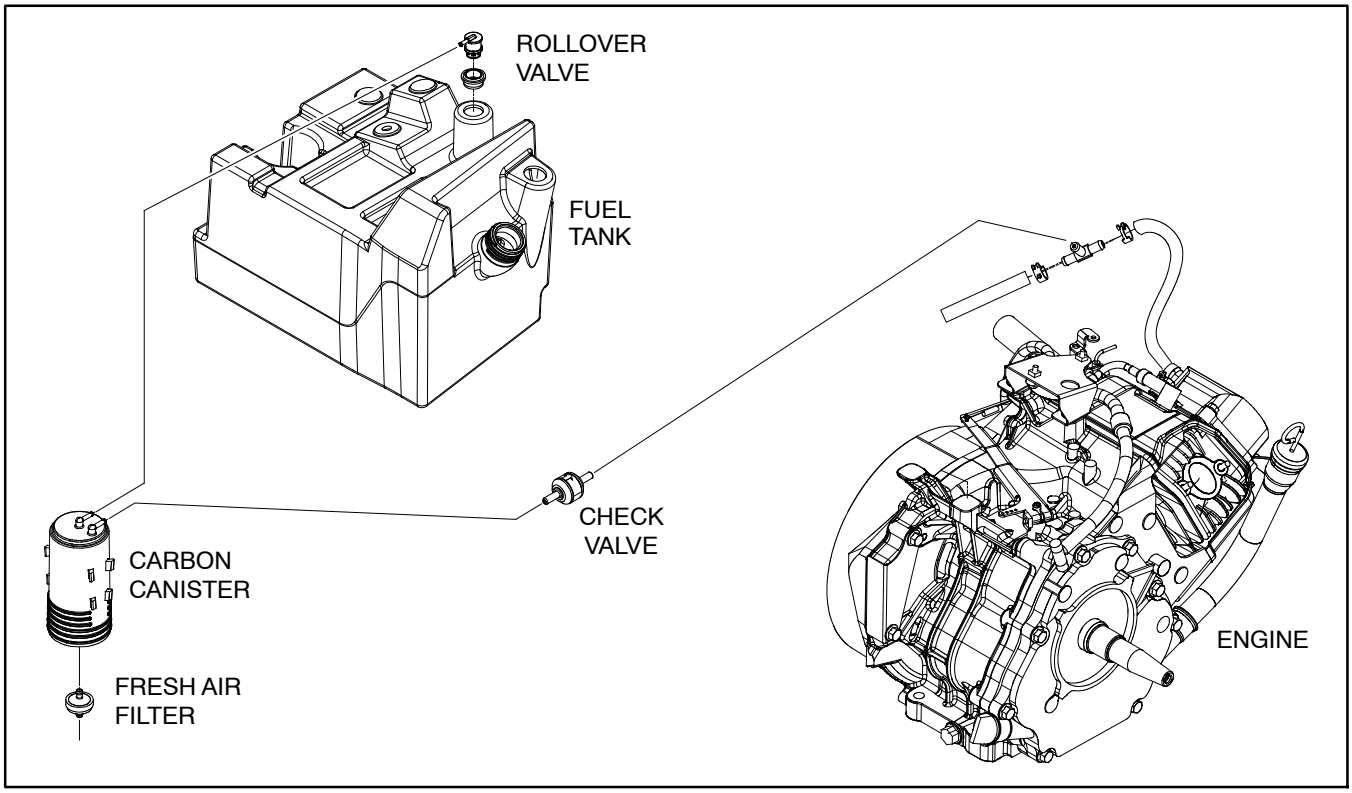


Figure 13

Workman MD vehicles with serial number above 310000000 are equipped with a fuel evaporative control system (EVAP) designed to collect and store evaporative emissions from the fuel tank. The EVAP uses a carbon canister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister where they are stored. Vapors from the canister are consumed when the engine is running which purges the canister.

The fuel tank on these Workman vehicles uses a non–vented fuel cap. To connect the tank to the evaporative control system, a rollover valve is positioned in the top of the tank that allows tank venting through the carbon canister.

**NOTE:** If there is restriction in the fresh air filter, the carbon canister or the rollover valve, the fuel tank may distort due to venting issues. If the fuel tank returns to it's normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

Machines with a carbon canister include a single engine connection to the engine intake system that is used to connect the evaporative system to the engine. These machines use an inline check valve between the carbon canister and the engine fitting. Evaporative control system components for Workman MD vehicles are shown in Figure 15.

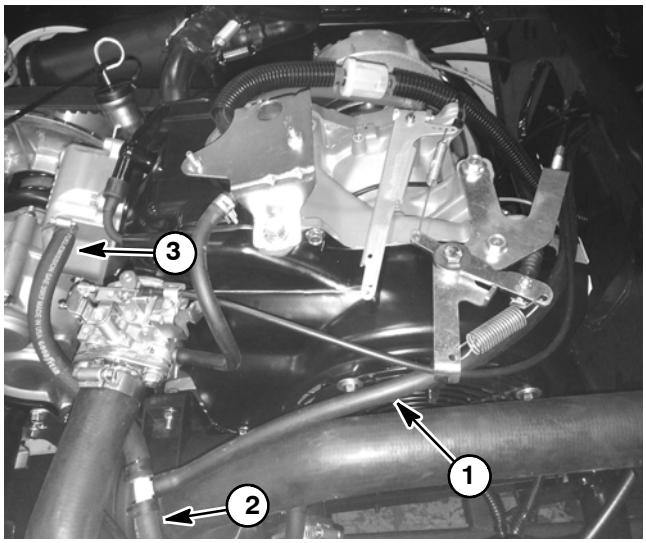


Figure 14

1. **Hose from check valve**
2. **Hose to air cleaner**
3. **Hose from engine**

**Disassembly**

**DANGER**

**Gasoline is flammable. Use caution when storing or handling it. Wipe up any spilled fuel before starting the engine.**

1. Inspect carbon cannister and attached hoses for damage or obvious leaks. A damaged or leaking cannister should be replaced.

2. Remove components as needed using Figure 15 as a guide.

A. If check valve (item 8 in Fig. 15) is removed, note direction of arrow on valve body for assembly purposes (Fig. 16).

B. Note location of hose clamps for assembly purposes.

**Assembly**

1. Install all removed components using Figure 15 as a guide.

A. If check valve (item 8 in Fig. 15) was removed, make sure that arrow on valve body points toward engine.

B. Make sure that fuel hoses are not kinked after installation. Also, secure hoses with hose clamps.

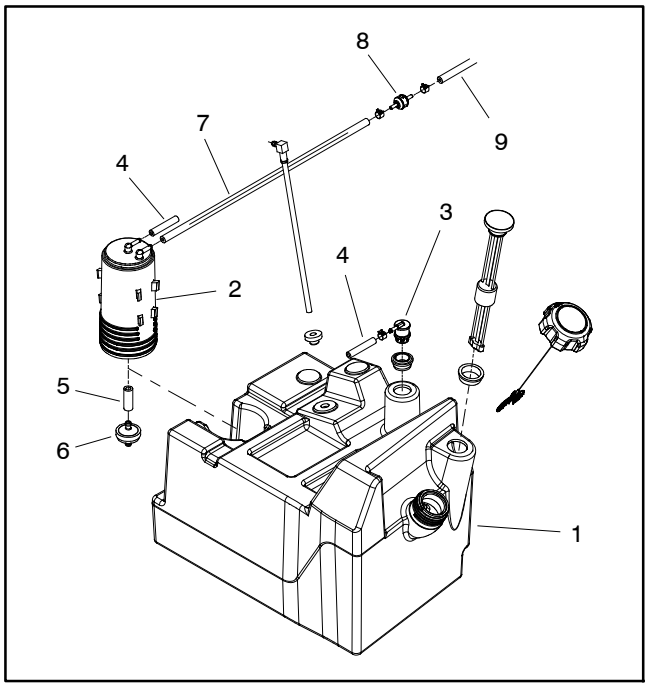


Figure 15

1. **Fuel tank**
2. **Carbon canister**
3. **Rollover valve**
4. **Fuel hose (tank vent)**
5. **Fuel hose**
6. **Fresh air filter**
7. **Fuel hose (purge hose)**
8. **Check valve**
9. **Fuel hose (to engine)**

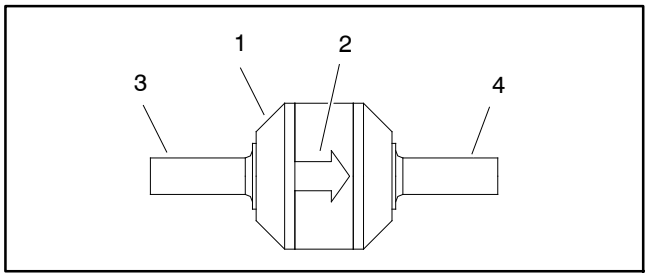


Figure 16

1. **Check valve**
2. **Directional arrow**
3. **Fitting from canister**
4. **Fitting to engine**

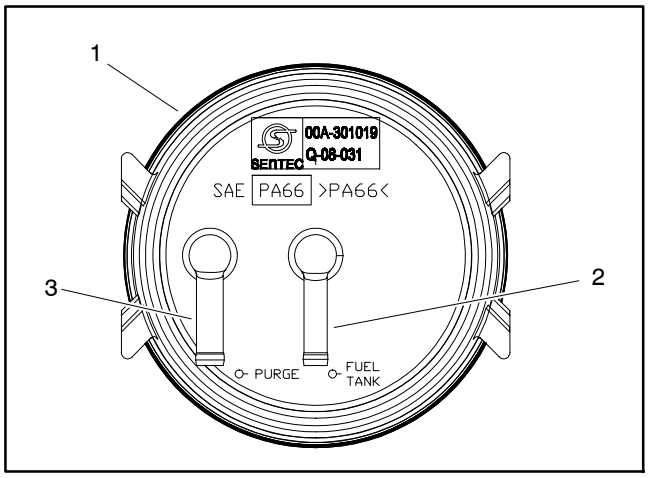


Figure 17

1. **Top of carbon canister**
2. **Fitting to rollover valve**
3. **Fitting to engine**

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# Chapter 5

# Drive Train

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# General Information

### Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

# Specifications

| Item | Description |
|---|---|
| Transaxle | |
| Transaxle Fluid Capacity | 1.5 quarts (1.4 liters) |
| Transaxle Fluid | SAE 10W–30 Motor Oil |
| Clutch System | Continuously variable transmission type, torque convertor |
| Drive Clutch | Speed sensing with mechanical fly weights |
| Driven Clutch | Torque sensing with spring loaded cam |

# Drive Train Operation

## Clutch System Operation

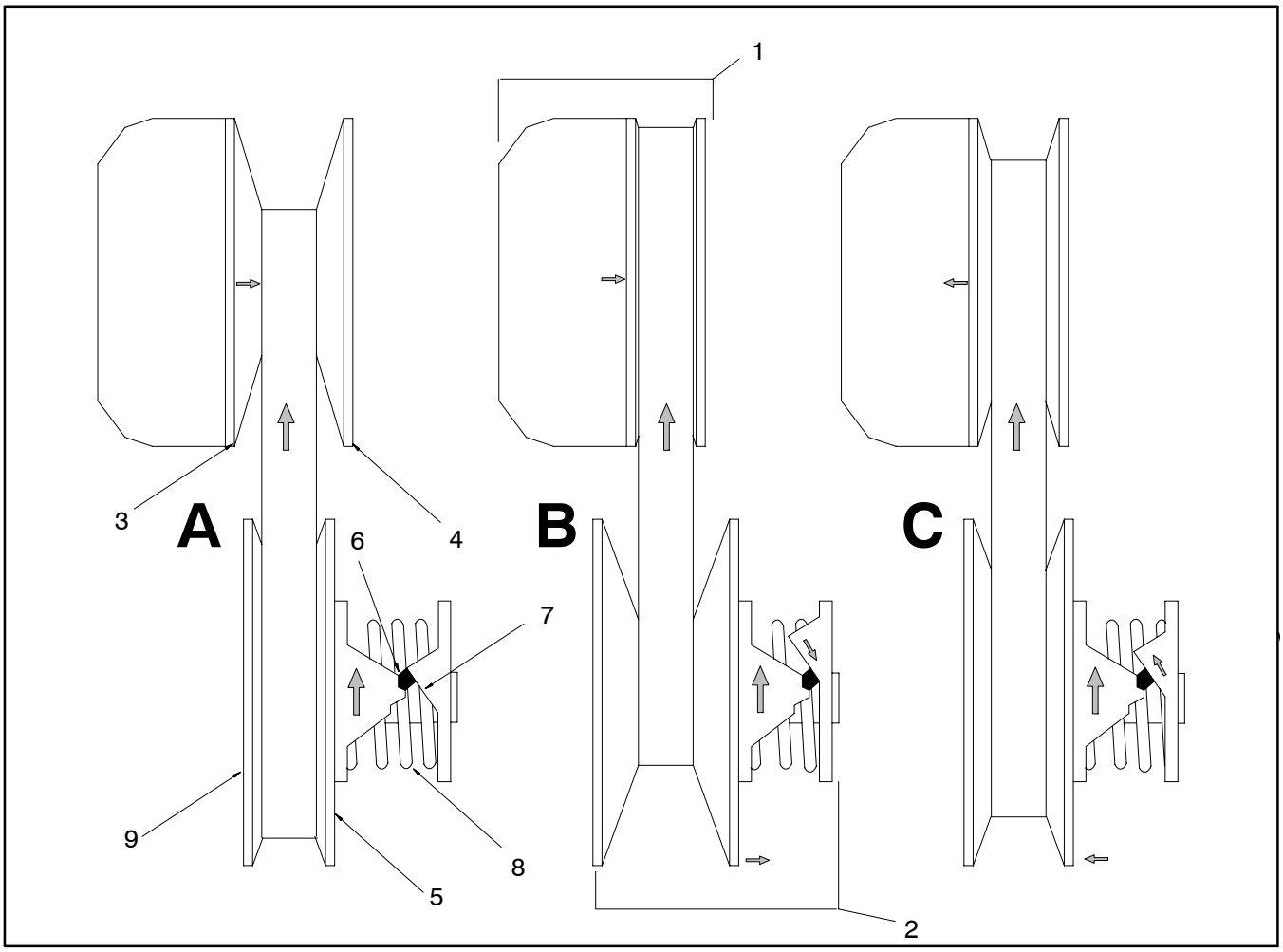


Figure 1

1. **Drive clutch (engine mounted)**
2. **Driven clutch (transaxle mounted)**
3. **Moveable sheave (drive clutch)**
4. **Fixed sheave (drive clutch)**
5. **Moveable sheave (driven clutch)**
6. **Button**
7. **Ramp (fixed cam)**
8. **Spring**
9. **Fixed sheave (driven clutch)**

Power is transferred from the engine to the transaxle by a variable clutch system that consists of two clutches connected by a drive belt. The drive clutch responds to engine speed, and is mounted to the engine drive shaft. The driven clutch responds to changes in load to the rear axle, and is mounted to the transaxle input shaft.

The two clutches work together to automatically up-shift and back-shift as changes in load and speed occur. This shifting changes the turning ratio between the drive and driven clutches and allows the engine to operate at optimum efficiency.

## Drive Clutch Operation

The operation of the drive clutch is affected by engine shaft speed. When the engine is off and not turning, the drive belt rests low within the drive clutch sheaves as the clutch sheaves are spaced apart. As the engine is started and increases in speed, the clutch weights move outward as they spin about the engine drive shaft. The outward movement of the weights against the spider assembly forces the moveable sheave closer to the fixed sheave. This inward movement of the moveable sheave engages the drive belt which begins to rotate.

With increasing engine speed, the moveable sheave continues to move inward. This sheave movement forces the drive belt to ride towards the outer diameter of the drive clutch sheaves which increases the drive belt speed.

When engine speed is decreased, the weights exert less force on the moveable sheave. The reduced force causes the moveable sheave to shift away from the fixed sheave and slows the drive belt speed. As engine speed continues to decrease, the drive belt disengages from the clutch sheaves.

The drive clutch used on vehicles with serial numbers below 310000000 (Fig. 2) includes three (3) rollers, three (3) cam weights and a spring to control operation of the moveable sheave.

The drive clutch used on vehicles with serial numbers above 310000000 (Fig. 3) controls moveable sheave operation with six (6) weighted rollers and ramp surfaces in the moveable sheave.

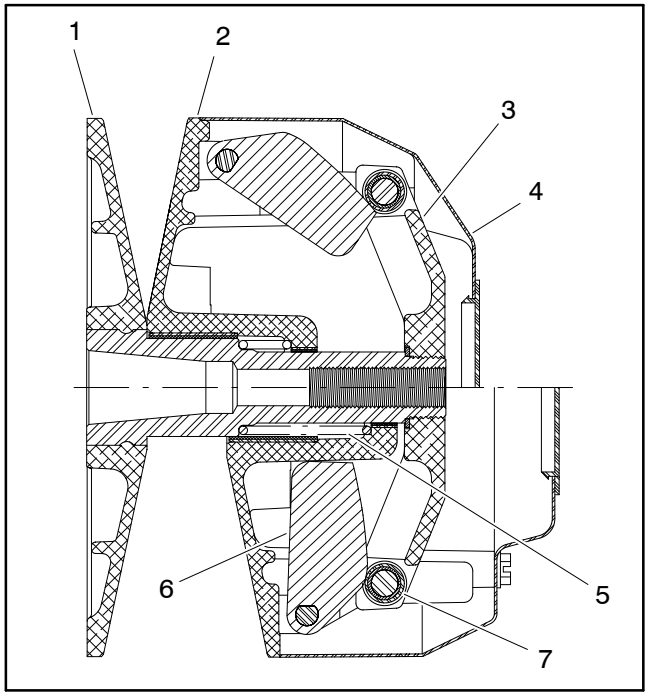


Figure 2

1. **Fixed sheave**
2. **Moveable sheave**
3. **Spider assembly**
4. **Cover**
5. **Spring**
6. **Cam weight (3 used)**
7. **Roller (3 used)**

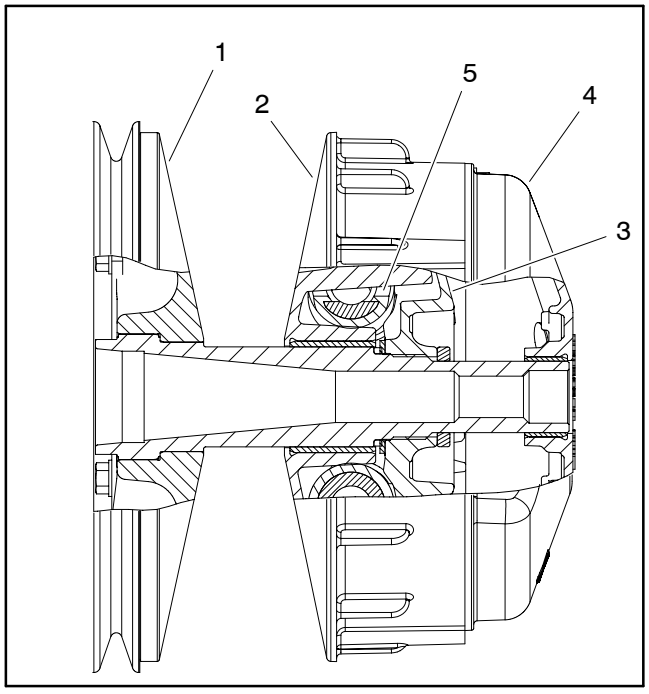


Figure 3

1. **Fixed sheave**
2. **Moveable sheave**
3. **Spider assembly**
4. **Cover**
5. **Roller (6 used)**

## Driven Clutch Operation

The operation of the driven clutch is affected by transaxle load. When the vehicle is stopped, the drive belt is held at the outer diameter of the driven clutch sheaves from the pressure of the spring pushing the moveable sheave against the fixed sheave and away from the fixed cam.

Once the drive belt starts rotating, the driven clutch also starts to rotate. With increasing speed of the drive clutch, the drive belt begins to climb to the outer diameter of the drive clutch sheaves. This increases the tension on the drive belt, and forces the moveable sheave of the driven clutch to move away from the fixed sheave against the pressure of the spring. As the belt tightens and the sheaves open up, the drive belt rides lower in the driven clutch sheaves.

With increased load to the transaxle, the fixed cam resists forward movement relative to the moveable sheave and drive belt. Torque from the drive belt and spring pressure moves the moveable sheave up the ramp of the fixed cam. The drive belt becomes positioned closer to the outer diameter of the driven clutch sheaves.

On vehicles with a serial number below 310000000, three (3) sets of buttons on the driven clutch moveable sheave provide a low friction surface on which the moveable sheave can slide on the ramp of the fixed cam (Fig. 4).

On vehicles with a serial number above 310000000, a fixed cam on the driven clutch moveable sheave rotates on a pair of rollers in the fixed sheave base to allow low friction movement of the moveable sheave (Fig. 5).

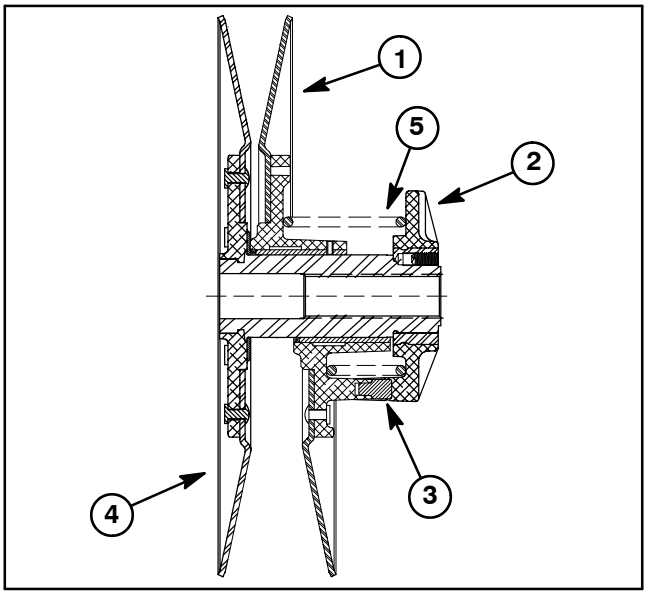


Figure 4

1. **Moveable sheave**
2. **Ramp (fixed cam)**
3. **Button**
4. **Fixed sheave**
5. **Spring**

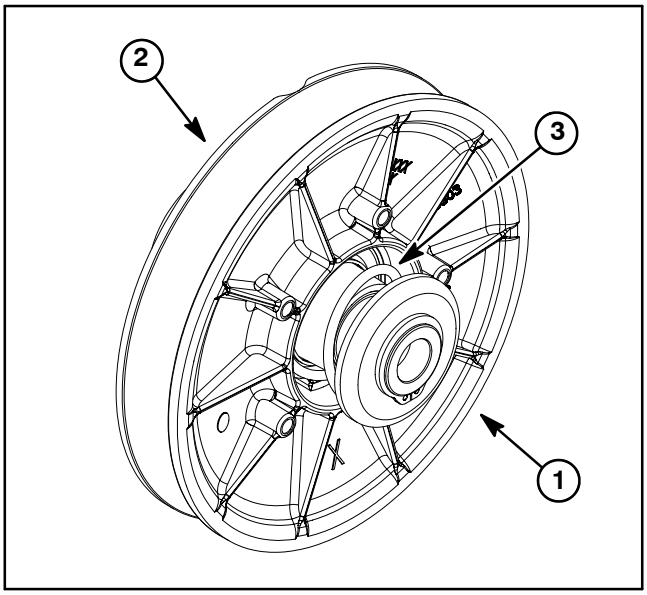


Figure 5

1. **Moveable sheave**
2. **Fixed sheave**
3. **Spring**

# Special Tools

Order special tools from your Toro Distributor.

## Drive Clutch Removal Tool (Serial Number Below 310000000)

This tool is required to remove the drive clutch from the tapered drive shaft of the engine. It is placed in the threaded hole of the fixed clutch sheave after the clutch holding cap screw is removed.

Toro Part Number: **TOR4094**

**NOTE:** Vehicles with a serial number below 310000000 are equipped with a Comet brand drive clutch.

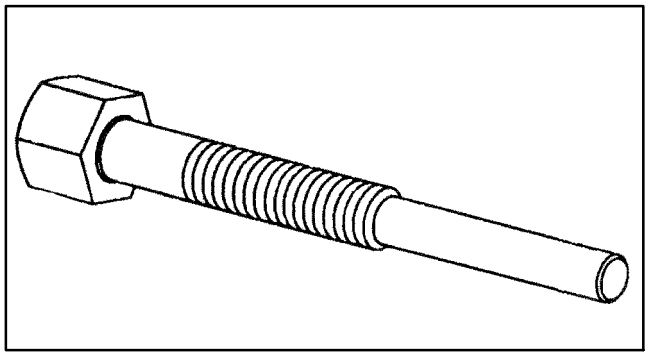

Figure 6

## Drive Clutch Spider Removal Tool Kit (Serial Number Below 310000000)

This kit is required to remove the drive clutch spider from the post of the fixed sheave. Kit includes spanner and clutch holding bar.

Toro Part Number: **TOR4098**

**NOTE:** Vehicles with a serial number below 310000000 are equipped with a Comet brand drive clutch.

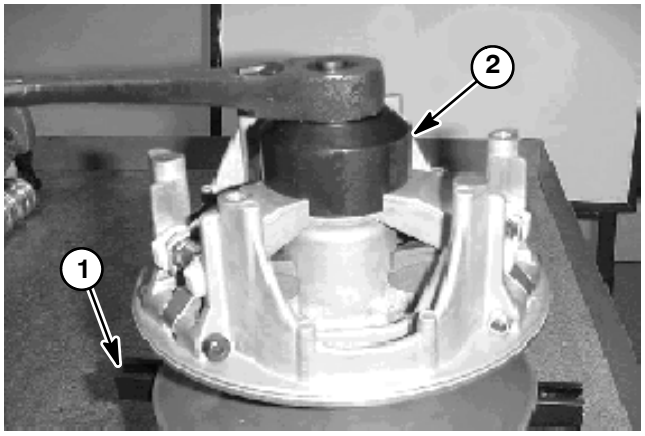


Figure 7

1. **Holding bar**
2. **Spanner**

## Clutch Dry Lubricant (Serial Number Below 310000000)

This lubricant should be used to properly lubricate drive clutch components on vehicles with serial numbers below 310000000.

Toro Part Number: **104-7011**

**NOTE:** Vehicles with a serial number below 310000000 are equipped with a Comet brand drive clutch.

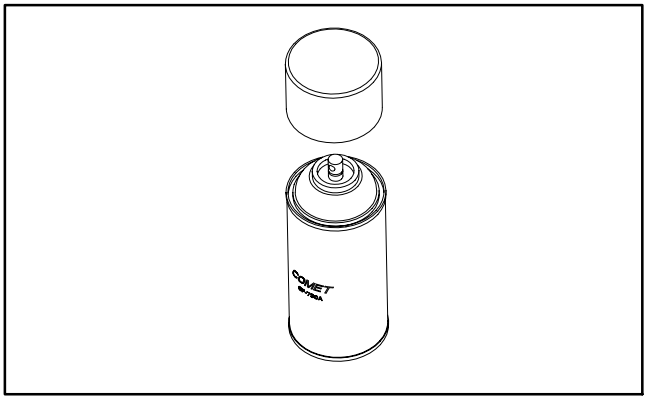


Figure 8

## Drive Clutch Removal Tool (Serial Number Above 310000000)

This tool is required to remove the drive clutch from the tapered drive shaft of the engine. It is placed in the threaded hole of the fixed clutch sheave after the clutch holding cap screw is removed.

Toro Part Number: **TOR6013**

**NOTE:** Vehicles with a serial number above 310000000 are equipped with a TEAM brand drive clutch.

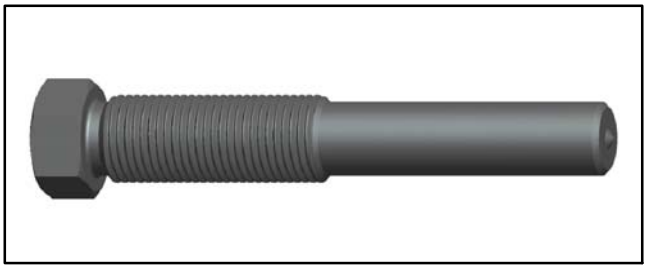

Figure 8.1

## Drive Clutch Spider Removal Tool Kit (Serial Number Above 310000000)

This kit is required to remove the drive clutch spider from the post of the fixed sheave. Kit includes spanner and clutch holding bar.

Toro Part Number: **TOR6016**

**NOTE:** Vehicles with a serial number above 310000000 are equipped with a TEAM brand drive clutch.

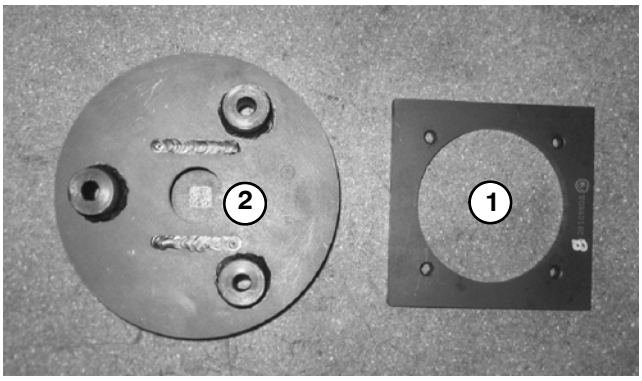


Figure 8.2

1. **Holding bar**
2. **Spanner**

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## Adjust Ground Speed (Workman MD with Serial Number Below 313000400)

Workman MD models with serial number below 313000400 are equipped with a transaxle governor. Adjust ground speed using the following procedure for these vehicles.

**WARNING**

**Vehicles operating at ground speeds greater than the recommended speed will require further distances to fully stop. Do not adjust ground speed greater than specified.**

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Raise and support cargo box.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Jack up rear of vehicle so both rear wheels are at least 1 inch (25mm) off the ground. Support the rear axle tubes on appropriate jack stands.

3. Chock front and rear of both front tires to prevent the vehicle from moving.

4. Make sure that the shift lever is in the neutral position.

5. Verify ground speed as follows:

   A. Start engine and hold accelerator pedal to the floor.

   B. Verify driven clutch RPM with a tachometer. With the accelerator pedal to the floor, the driven clutch speed should be from **3550 to 3650 RPM**.

6. If ground speed adjustment is necessary, drill out anodized rivet and retain anti-tamper bracket for reinstallation (Fig. 9).

7. Adjust throttle cable (accelerator pedal to transaxle) at the cable bracket until the correct driven clutch RPM is obtained with the accelerator pedal fully to the floor (Fig. 9).

8. Install anti-tamper bracket to the cable bracket using a new anodized rivet (Toro P/N 99-7122) (Fig. 9).

9. Lower machine to ground. Lower and secure cargo box.

**NOTE:** If unable to identify the driven clutch RPM, an alternate method to verify ground speed would be to determine the distance that the vehicle will travel on level ground in three (3) seconds with the accelerator pedal to the floor. The Workman MD should travel 62 feet (18.8 meters) in three seconds. If necessary, adjust ground speed using steps 6 through 8 above.

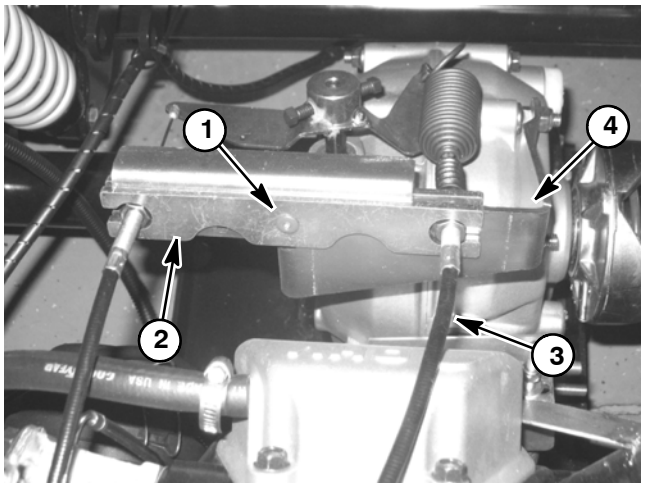


Figure 9

1. **Anodized rivet**
2. **Anti-tamper bracket**
3. **Throttle cable**
4. **Cable bracket**

## Adjust Ground Speed (Workman MDX and Workman MD with Serial Number Above 313000400)

All Workman MDX models and Workman MD models with serial number above 313000400 use an engine governor for speed control. Adjust ground speed using the following procedure for these vehicles.

**WARNING**

**Vehicles operating at ground speeds greater than the recommended speed will require further distances to fully stop. Do not adjust ground speed greater than specified.**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Make sure that the shift lever is in the neutral position.

3. Verify engine speed to ensure correct ground speed as follows:

   A. Start engine and hold accelerator pedal to the floor.

   B. Using a tachometer, verify that engine RPM is from **3250 to 3350 RPM** with the accelerator pedal to the floor.

   **NOTE:** If phototac is to be used to measure engine speed, DO NOT use driven clutch on transaxle for speed measurement.

   C. If engine RPM is incorrect, refer to the appropriate engine service manual (Briggs and Stratton Repair Manual for MDX vehicles or Kohler Service Manual for MD vehicles) for governor adjustment procedure.

4. Lower and secure cargo box after adjustments are complete.

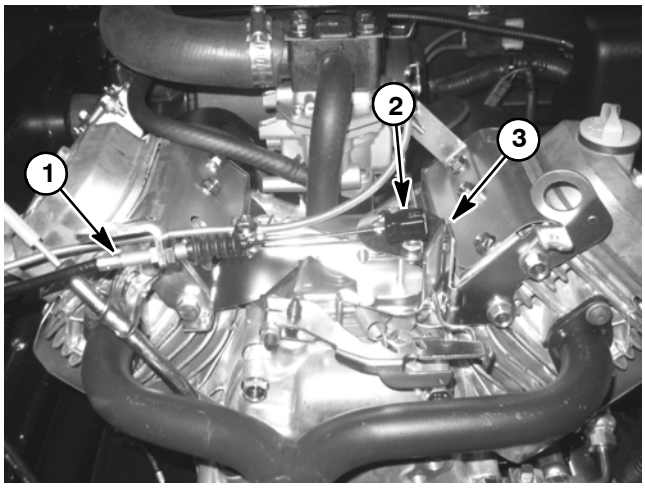


Figure 10

1. **Accelerator cable**
2. **Accelerator cable end**
3. **Governor control**

## Adjust Shift Cables

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Set the shift lever into the Neutral position. Rotate driven clutch to insure transmission is in neutral.

3. The transaxle select lever assembly should be in a level position and parallel to the cable mounting bracket.

4. While holding the cable below the lever, tighten the lock nut on one of the shift cables to allow 0.030" to 0.060" (0.8 to 1.5 mm) freeplay in the cable (Fig. 11).

5. Repeat process for other shift cable.

6. Pull up on each shift cable to make sure that freeplay is correct. If necessary, readjust nut (Fig. 11).

7. Start engine and verify transaxle engagement in forward, reverse and neutral as the shift lever is moved.

8. Finally, check vehicle operation in forward, reverse and neutral. Readjust shift cables if needed for correct operation.

9. Lower and secure cargo box.

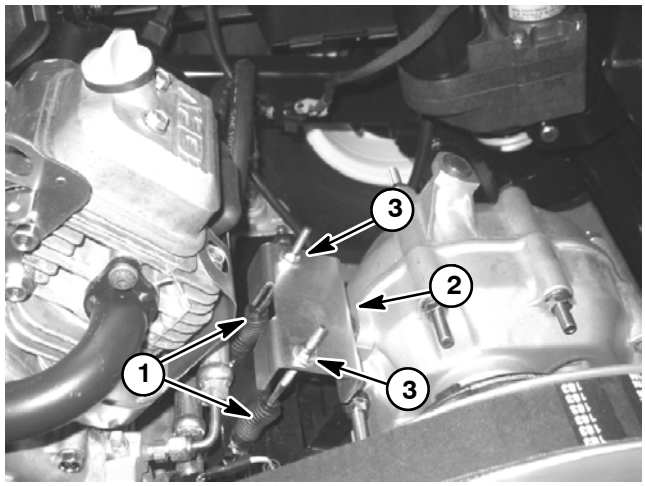


Figure 10

1. Shift cable
2. Select lever assembly
3. Lock nut

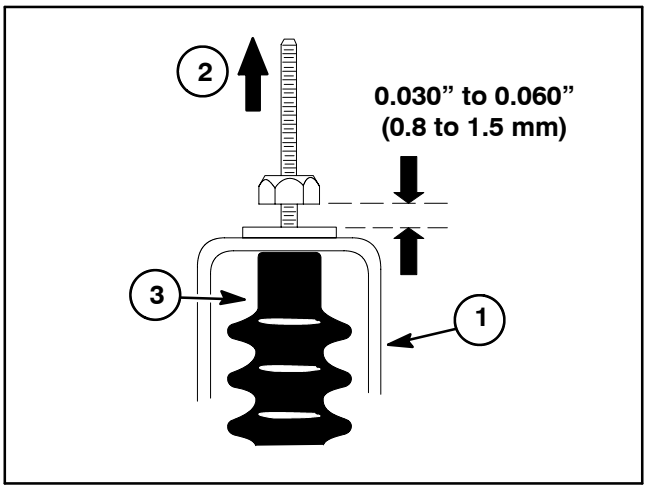


Figure 11

1. Select lever
2. Cable pull direction
3. Cable boot

## Drive Clutch

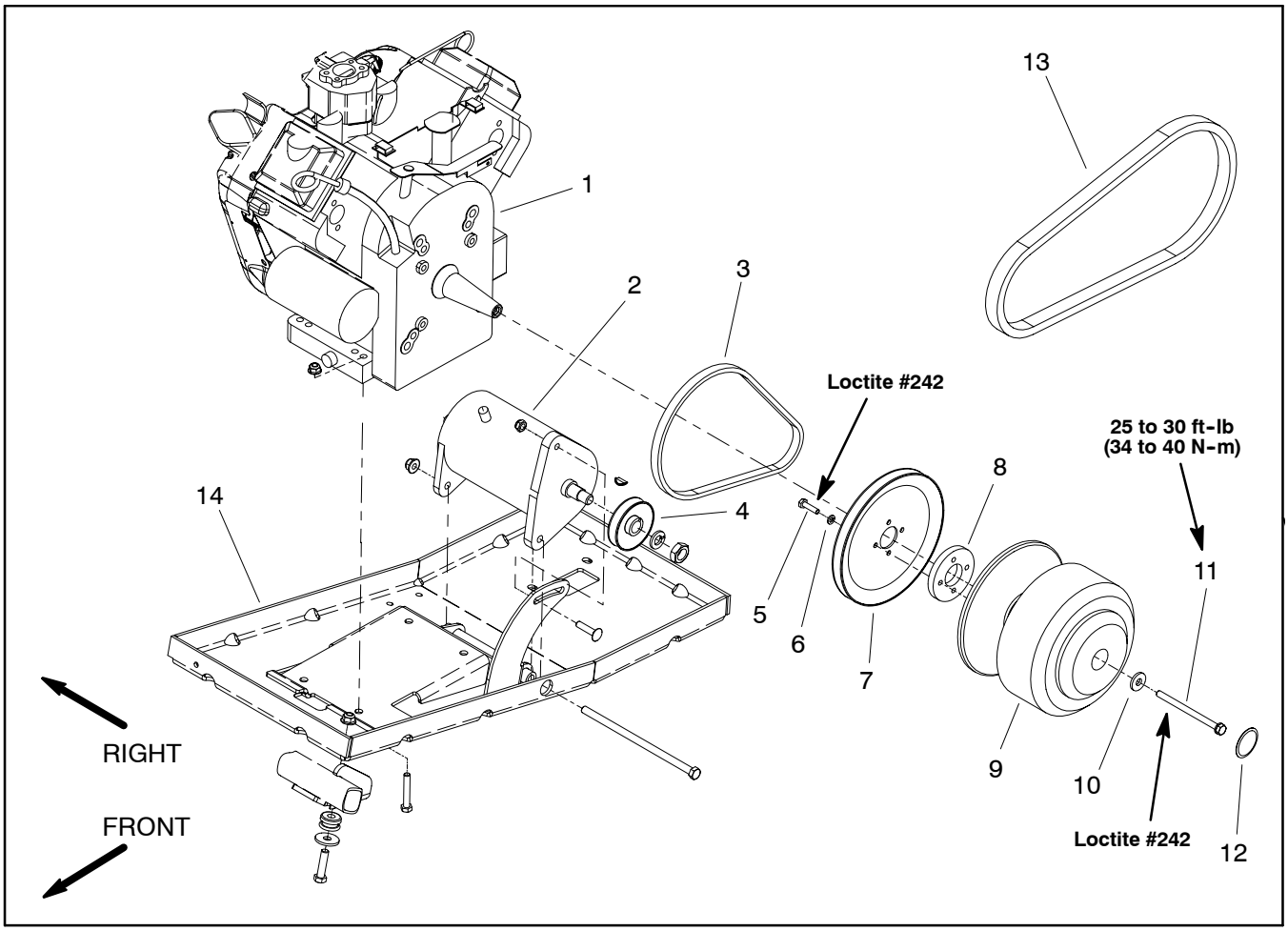


Figure 12

1. Engine (V-twin shown)
2. Starter/generator
3. Starter/generator belt
4. Starter/generator pulley
5. Cap screw (4 used)
6. Lock washer (4 used)
7. Engine starter pulley
8. Spacer
9. Drive clutch
10. Washer
11. Cap screw
12. Plastic cap
13. Drive belt
14. Engine tray

### Drive Clutch Lubrication

**NOTE:** Lubricate drive clutch at the interval specified in your Operator's Manual.

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Raise and support cargo box.

2. Remove the three (3) cap screws that secure the cover to the drive clutch (Fig. 13). Remove the cover from the clutch.

**WARNING**

**When using compressed air for cleaning the clutch, the dust in the clutch will become airborne and could damage your eyes or you could inhale it causing breathing difficulties.**

**Wear safety goggles and a dust mask or other eye and respiratory protection when performing this procedure.**

**NOTE:** The drive clutch on vehicles with serial numbers above 310000000 is different than the clutch used on earlier vehicles. The procedure to remove or install the drive clutch is the same regardless of machine serial number.

**Drive Clutch Removal (Fig. 13)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Remove drive belt from the drive clutch.

3. Remove starter/generator V-belt from the engine pulley.

4. On vehicles with serial numbers below 310000000, carefully remove plastic cap (item 12) from the drive clutch.

5. Remove cap screw and washer securing the drive clutch to the engine tapered shaft.

**IMPORTANT: Lightly grease end of clutch removal tool to prevent wear or damage to removal tool and crankshaft. Prevent damage to clutch threads; thread tool only enough to remove the clutch.**

6. Use correct clutch removal tool (see Special Tools) to remove drive clutch from the engine tapered shaft.

**Drive Clutch Installation (Fig. 13)**

1. Thoroughly clean the tapered surfaces of the engine crankshaft and drive clutch.

2. Slide drive clutch onto the engine shaft.

3. Apply Loctite #242 (or equivalent) to the threads of the cap screw.

4. Secure clutch to shaft with cap screw and washer. Torque cap screw from **25 to 30 ft-lb (34 to 40 N-m)**.

5. On vehicles with serial numbers below 310000000, carefully install plastic cap to the drive clutch.

6. Install starter/generator V-belt to the engine and starter pulley. Adjust belt tension.

7. Install drive belt to the drive clutch.

8. Lower and secure cargo box.

## Drive Clutch Service (Serial Number Below 310000000)

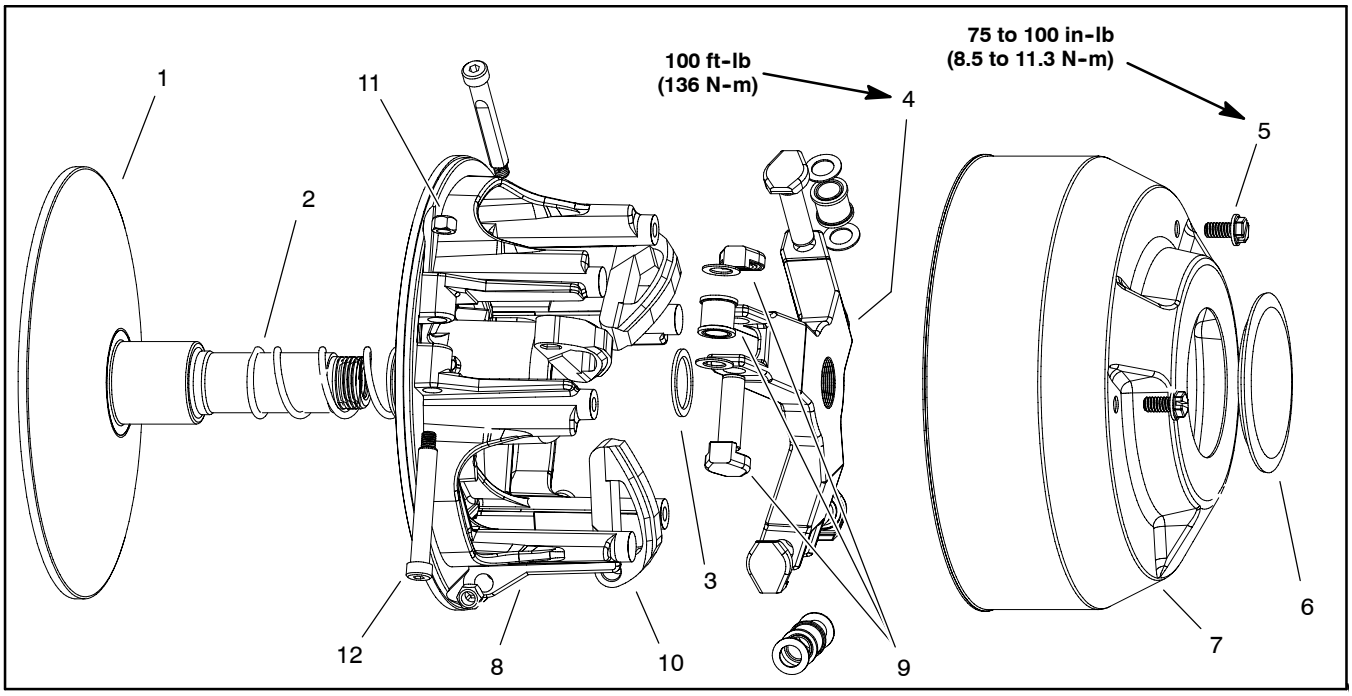


Figure 14

1. **Fixed sheave**
2. **Spring**
3. **Washer**
4. **Spider assembly**
5. **Cap screw (3 used)**
6. **Plastic cap**
7. **Cover**
8. **Moveable sheave**
9. **Roller kit (3 used)**
10. **Cam weight (3 used)**
11. **Lock nut (3 used)**
12. **Pilot bolt (3 used)**

**NOTE:** Vehicles with a serial number below 310000000 are equipped with a Comet brand drive clutch.

**Drive Clutch Lubrication**

**NOTE:** Lubricate drive clutch at the interval specified in your Operator's Manual.

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Raise and support cargo box.

2. Remove the three (3) cap screws that secure the cover to the drive clutch (Fig. 14). Remove the cover from the clutch.

**WARNING**

**When using compressed air for cleaning the clutch, the dust in the clutch will become airborne and could damage your eyes or you could inhale it causing breathing difficulties. Wear safety goggles and a dust mask or other eye and respiratory protection when performing this procedure.**

3. Using compressed air, thoroughly clean the inside of the clutch cover and the clutch components.

4. Lubricate the clutch components in areas shown in Figure 15 using Toro Dry Lubricant Spray (see Special Tools). Avoid getting lubricant on drive belt.

5. Install cover to clutch and secure with three (3) cap screws. Torque cap screws from **75 to 100 in-lb (8.5 to 11.3 N-m)**.

6. Lower and secure cargo box.

**Drive Clutch Disassembly (Fig. 14)**

**IMPORTANT: Do not pry off cover, damage may result. Cover should pop off.**

1. Remove three (3) cap screws securing the cover to the moveable sheave. Pull cover from clutch.

2. Remove four (4) cap screws and lock washers that secure the engine starter pulley and starter spacer to the drive clutch. Remove pulley and spacer from clutch.

3. Use two 1/4–20 X 1" cap screws to secure the spider removal holding bar (see Special Tools) to drive clutch (Fig. 16).

4. Secure clutch with attached spider removal holding bar in a vise. Matchmark position of spider and moveable sheave for reassembly purposes.

**CAUTION**

**Remove spider from fixed sheave slowly. The moveable sheave is under pressure from the spring.**

**IMPORTANT: Use spider removal spanner to remove spider. Unequal pressure on the cam towers may damage them.**

5. Using spider removal spanner (see Special Tools), remove spider from the fixed sheave post (Fig. 16).

6. As needed, remove cam weights from moveable sheave and roller kits from spider using Figure 14 as a guide.

**Drive Clutch Inspection**

1. Inspect the tapered ends of the crankshaft and primary fixed sheave for scratches. If either is severely scratched, replace component. If scratches are minor, burnish the component with emery cloth.

2. Check the surface of the cam weights (Fig. 17). If worn, replace all cam weights as a set.

3. Check the rollers (Fig. 18). If binding or uneven wear is found, replace all rollers as a set.

4. Clean pilot bolts and roller pins with 800 – 1000 grit abrasive paper. If the chrome–plated surface of the bolts or pins is scaled off, replace the damaged components.

5. Check the contact surface of the moveable sheave for wear and/or fraying. If surface is worn/frayed, replace component.

6. Inspect the clutch spring and replace if damaged or fatigued.

**Drive Clutch Assembly (Fig. 14)**

1. If removed, install rollers, washers and roller pins to spider. Roller pins should be lubricated with Toro part #104–7011 (see Special Tools).

2. Lubricate cam weights with Toro part #104–7011 (see Special Tools). Make sure lubricant penetrates to pilot bolts by rotating and sliding the weights side to side, or remove weights if needed to lubricate properly.

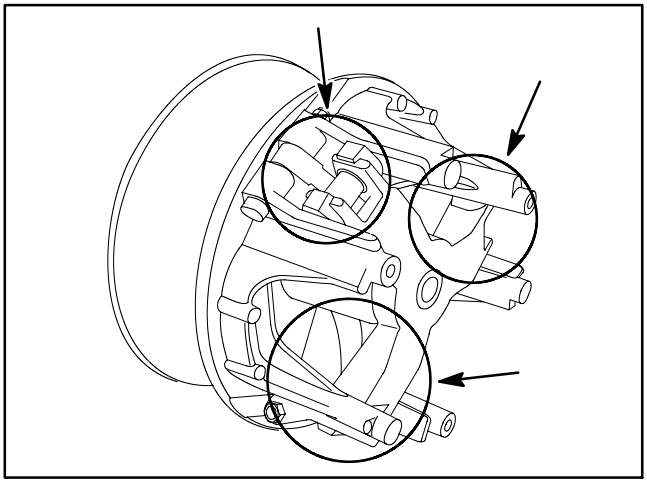

Figure 15

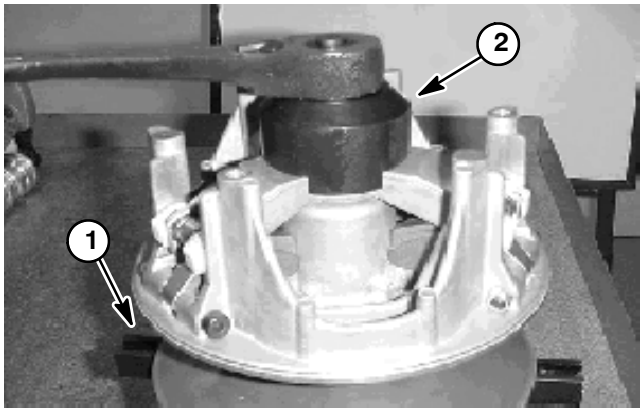


Figure 16

1. Holding bar
2. Spanner

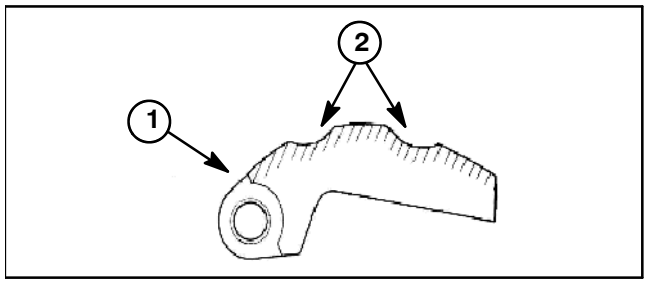


Figure 17

1. Cam weight
2. Worn contact surface

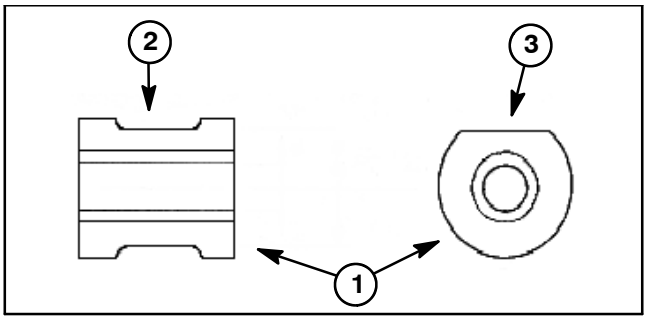


Figure 18

1. Roller
2. Weight contact surface
3. Roller uneven wear

3. Assemble cam weights to moveable sheave as follows:

A. Make sure the threads of the pilot bolts are clean and dry. Apply Loctite #271 (or equivalent) to the threads of each bolt.

**IMPORTANT: To maintain the balance of the clutch, all pilot bolts must be installed with their threads pointing in a clockwise direction (Fig. 19).**

B. Immediately install new lock nuts on the pilot bolts. Tighten nuts until they just touch the sheave casting. Never reuse lock nuts.

4. Apply Loctite #271 (or equivalent) to the threads of the fixed sheave post.

5. Install spider to the fixed sheave post using spider removal tool kit (see Special Tools). Make sure to align matchmark made during disassembly.

6. Torque spider to **100 ft-lb (136 N-m)**.

7. Install engine starter pulley to the drive clutch as follows:

A. Insert four (4) cap screws through lock washers, pulley and spacer.

B. Apply Loctite #242 (or equivalent) to the threads of the cap screws.

C. Secure pulley and starter spacer to the clutch with cap screws.

8. Position cover to clutch. Secure cover to the moveable sheave with three (3) cap screws. Torque cap screws from **75 to 100 in-lb (8.5 to 11.3 N-m)**.

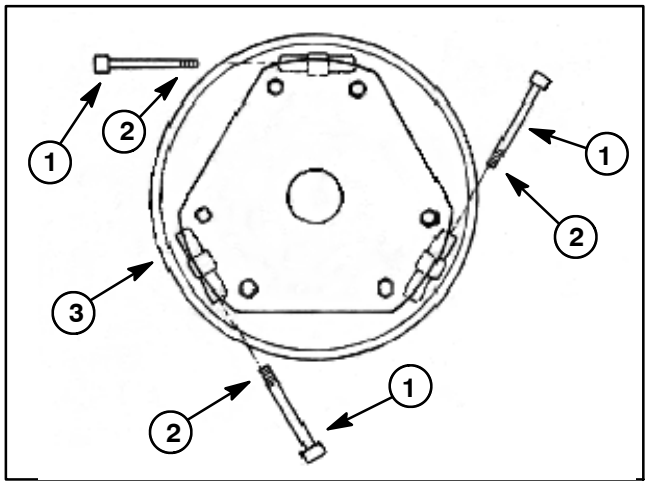


Figure 19

1. **Pilot bolt**
2. **Pilot bolt threads**
3. **Moveable sheave**

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## Drive Clutch Service (Serial Number Above 310000000)

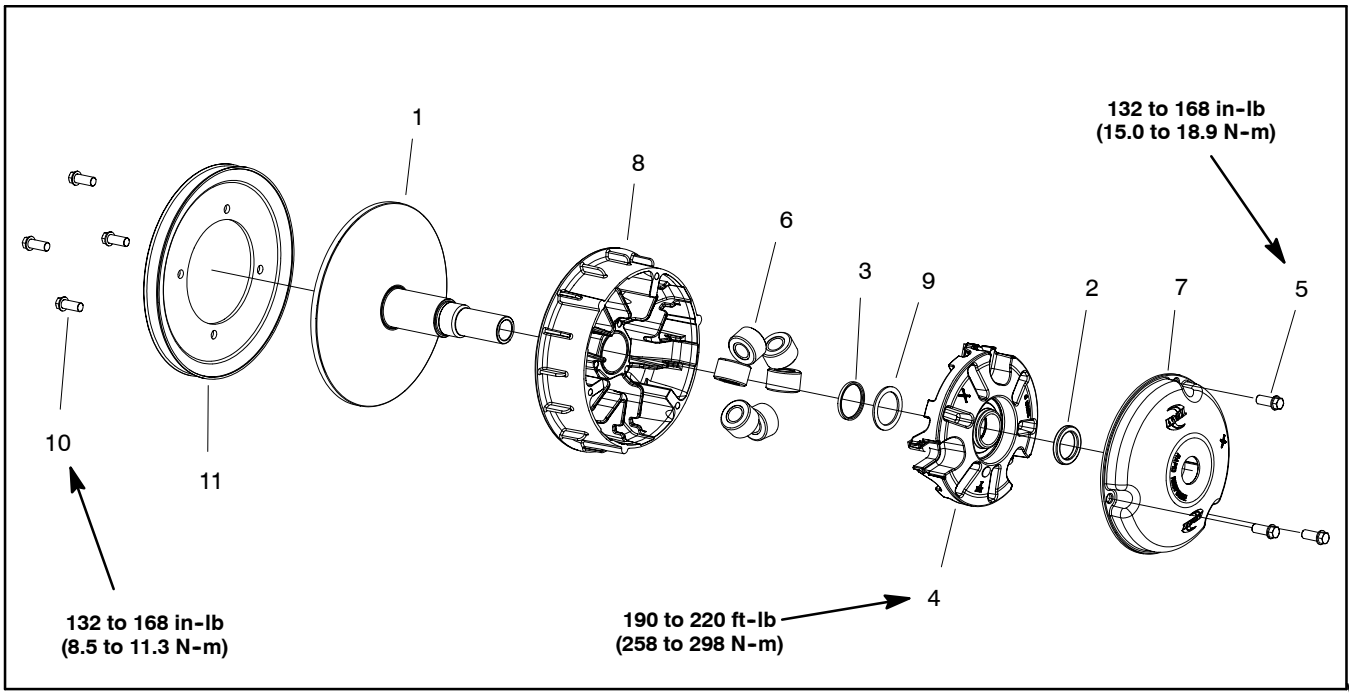


Figure19.1

1. **Fixed sheave**
2. **Limiter shim**
3. **Shim**
4. **Spider**
5. **Cap screw (3 used)**
6. **Roller (6 used)**
7. **Cover**
8. **Moveable sheave**
9. **Shim**
10. **Cap screw (4 used)**
11. **Engine starter pulley**

**NOTE:** Vehicles with a serial number above 310000000 are equipped with a TEAM brand drive clutch.

**Drive Clutch Disassembly (Fig. 19.1)**

**IMPORTANT: During clutch disassembly, note location of shims (items 2, 3 and 9) for assembly purposes. Correct shim location is necessary for proper clutch operation.**

**IMPORTANT: Make note of the "X" mark cast into the cover, spider and moveable sheave before clutch disassembly. These marks must be aligned during assembly for proper clutch operation.**

1. Remove three (3) cap screws securing the cover to the moveable sheave. Note location of "X" marks cast on the cover and spider for assembly purposes. Pull cover from clutch.

2. Remove limiter shim (item 2) from clutch. Label shim and its location for assembly purposes.

3. Make sure that engine starter pulley (item 11) has been removed from the drive clutch (see Drive Clutch Removal in this section).

4. Use starter pulley cap screws to secure the spider removal holding bar (see Special Tools) to drive clutch.

5. Secure clutch with attached spider removal holding bar in a vise. Note location of "X" marks cast on the spider and moveable sheave for assembly purposes.

**IMPORTANT: Use spider removal spanner to remove spider. Unequal pressure on the spider during removal may damage the spider.**

6. Using spider removal spanner (see Special Tools), remove spider (item 4) from the fixed sheave post (Fig. 19.2).

7. Remove shims (items 3 and 9) from fixed sheave post. Label shims and their location for assembly purposes.

8. As needed, remove rollers from moveable sheave.

9. If necessary, remove moveable sheave from fixed sheave.

**Drive Clutch Inspection**

**NOTE:** If drive clutch wear or damage occurs, clutch replacement may be necessary. Refer to your parts catalog to identify individual drive clutch components that are available.

1. Inspect the tapered ends of the engine crankshaft and fixed sheave of drive clutch. If either is severely damaged, replace component as damage to the taper will allow loosening of the clutch during machine operation.

2. Check all of the rollers. If binding or uneven wear is found, replace all rollers as a set.

3. Check the contact surface of the moveable sheave for wear and/or fraying. If surface is worn/frayed, replace component.

**Drive Clutch Assembly (Fig. 19.1)**

**IMPORTANT: For proper clutch operation, make sure to use the correct clutch components for your Workman model and serial number. Do not mix clutch components from different vehicles.**

**IMPORTANT: For proper drive clutch operation, DO NOT lubricate drive clutch components.**

1. If removed, install moveable sheave onto post of fixed sheave.

2. If removed, install rollers to pockets in moveable sheave. Rollers **should not** be lubricated.

3. Using labels made during disassembly to identify shims, place shims (items 3 and 9) onto fixed sheave post.

4. Install spider to the fixed sheave post using spider tool kit (see Special Tools). Make sure that the "X" mark cast into the spider and moveable sheave are aligned. Torque spider from **190 to 220 ft-lb (258 to 298 N-m)**.

5. Install limiter shim (item 2) onto the fixed sheave post.

6. Position cover to clutch. Make sure that the "X" mark cast into the cover, spider and moveable sheave are aligned.

7. Secure cover to the moveable sheave with three (3) cap screws. Torque cap screws from **132 to 168 in-lb (15.0 to 18.9 N-m)**.

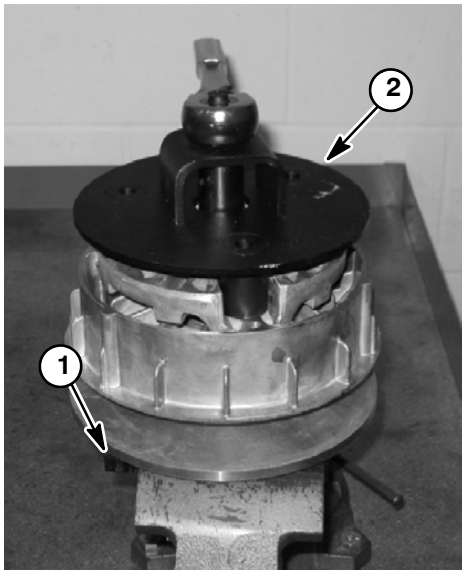


Figure 19.2

**1. Holding bar** **2. Spanner**

## Driven Clutch

**NOTE:** The driven clutch on vehicles with serial numbers above 310000000 is different than the clutch used on earlier vehicles. The procedure to remove or install the driven clutch is the same regardless of machine serial number.

### Driven Clutch Removal (Fig. 20)

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Remove muffler from the engine and engine mount (see Exhaust System Removal in Engine Chapter).

3. Remove drive belt from the driven clutch.

4. Remove cap screw and stepped washer securing the driven clutch to the input shaft of the transaxle.

5. Pull driven clutch from the transaxle input shaft.

### Driven Clutch Installation (Fig. 20)

1. Coat transaxle input shaft with antiseize lubricant.

2. Position driven clutch to the input shaft. Make sure pulley side of the clutch faces away from the transaxle case.

3. Secure driven clutch to the transaxle input shaft with cap screw and stepped washer. Torque cap screw from **39 to 47 ft-lb (53 to 63 N-m)**.

4. Install drive belt to the driven clutch.

5. Install muffler to the engine and engine mount (see Exhaust System Installation in the Service and Repairs section of Engine Chapter).

6. Lower and secure cargo box.

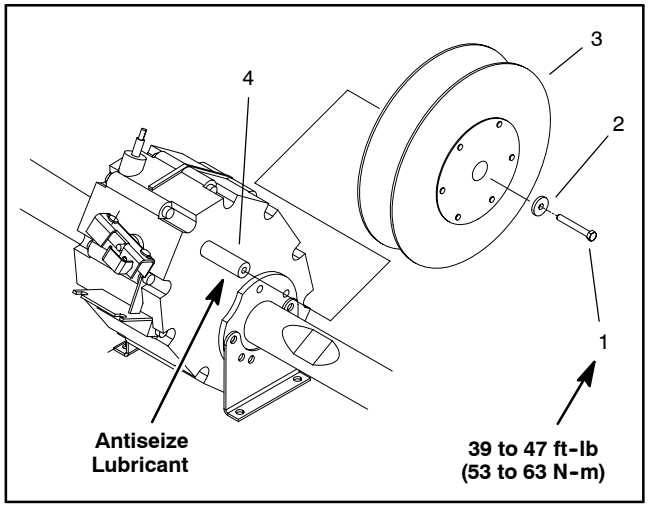


Figure 20

1. **Cap screw**
2. **Stepped washer**
3. **Driven clutch**
4. **Input shaft (transaxle)**

## Driven Clutch Service (Serial Number Below 310000000)

**NOTE:** Vehicles with a serial number below 310000000 are equipped with a Comet brand driven clutch.

**Ramp Button Replacement (Fig. 21)**

1. Park vehicle on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Remove drive belt from the driven clutch (see Service Drive Belt in Service and Repairs section of Engine Chapter).

3. Turn fixed and moveable sheaves in opposite directions so button is separated sufficiently enough from the ramp to allow removal.

4. Place small block of wood between the outer ramps to keep the ramps apart.

**CAUTION**

**To prevent burns, hold allen wrench with locking pliers when heating allen wrench.**

5. Clamp long end of a 2 mm allen wrench with locking pliers. Heat short end of the allen wrench until it is red hot.

6. Insert hot end of the allen wrench into the button so it melts around the end of the wrench. Hold wrench in place until the button hardens.

7. Pull and twist on the allen wrench to remove the button from the ramp.

**NOTE:** If the new button is difficult to install, sand its mounting tab as necessary. If the button is loose, apply Loctite #242 (or equivalent) on its mounting tab.

8. Install new button to ramp. Push button in straight with a screw driver by prying against the ramp.

9. As needed, remove and install remaining buttons.

10. Carefully remove block of wood that was placed to keep the clutch ramps apart.

11. Install drive belt to the driven clutch.

12. Lower and secure cargo box.

**Check Driven Clutch Spring Tension (Fig. 21)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch. Raise and support cargo box.

2. Place transaxle in gear to prevent the fixed sheave from moving.

3. Remove drive belt from the driven clutch.

**IMPORTANT: Use protective strips of soft metal when clamping the moveable sheave with locking pliers to prevent damage to the sheave.**

4. Clamp moveable sheave with locking pliers.

5. Measure spring torsion.

   A. Pull scale tangentially to the outer diameter of the moveable sheave.

   B. When the button on the ramp of the moveable sheave is 0.125 inch (3.18 mm) from the ramp of the fixed sheave, read the scale.

   C. The reading should be 16 to 20 lbf (71 to 89 N).

6. If the above specification is not met, replace the driven clutch.

7. Install drive belt to driven clutch.

8. Lower and secure cargo box.

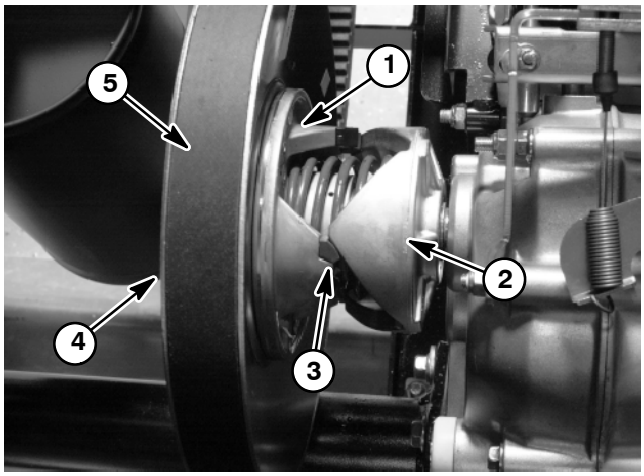


Figure 21

1. **Moveable sheave**
2. **Ramp (fixed cam)**
3. **Button**
4. **Fixed sheave**
5. **Drive belt**

## Driven Clutch Service (Serial Number Above 310000000)

**NOTE:** Vehicles with a serial number above 310000000 are equipped with a TEAM brand driven clutch (Fig. 21.1).

1. Use a suitable press to compress the clutch spring enough to allow removal of the retaining ring (item 7).

2. Remove retaining ring.

3. Carefully, allow the spring to extend fully.

4. Remove outer spring retainer, spring and inner spring retainer from clutch.

5. Make note of the "X" mark cast into the fixed sheave and moveable sheave before removing the moveable sheave. These marks must be aligned during assembly for proper clutch operation.

6. Separate the clutch sheaves. Locate and retrieve thrust washer.

7. Clean and inspect driven clutch components:

   A. Clean all dust and debris from clutch components. If necessary, use contact or brake cleaner to remove any oil or other lubricants from clutch components.

   B. Inspect the spring and replace if damaged or fatigued.

   C. Check the rollers in the fixed sheave for binding or wear. If binding or uneven wear is found, replace driven clutch assembly.

   D. Check the contact surface of the sheaves for wear and/or fraying. If wear or damage is found, replace driven clutch assembly.

**IMPORTANT: For proper driven clutch operation, DO NOT lubricate driven clutch components.**

8. Assemble the driven clutch in the reverse order of disassembly. Make sure that the "X" mark cast into the fixed and moveable sheaves are aligned. Also, make sure that the retaining ring is fully seated in groove after installation.

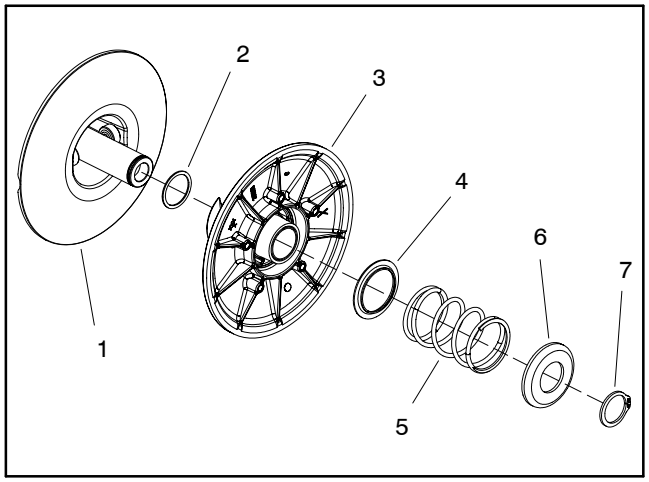


Figure 21.1

1. **Fixed sheave**
2. **Thrust washer**
3. **Moveable sheave**
4. **Inner spring retainer**
5. **Spring**
6. **Outer spring retainer**
7. **Retaining ring**

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## Transaxle

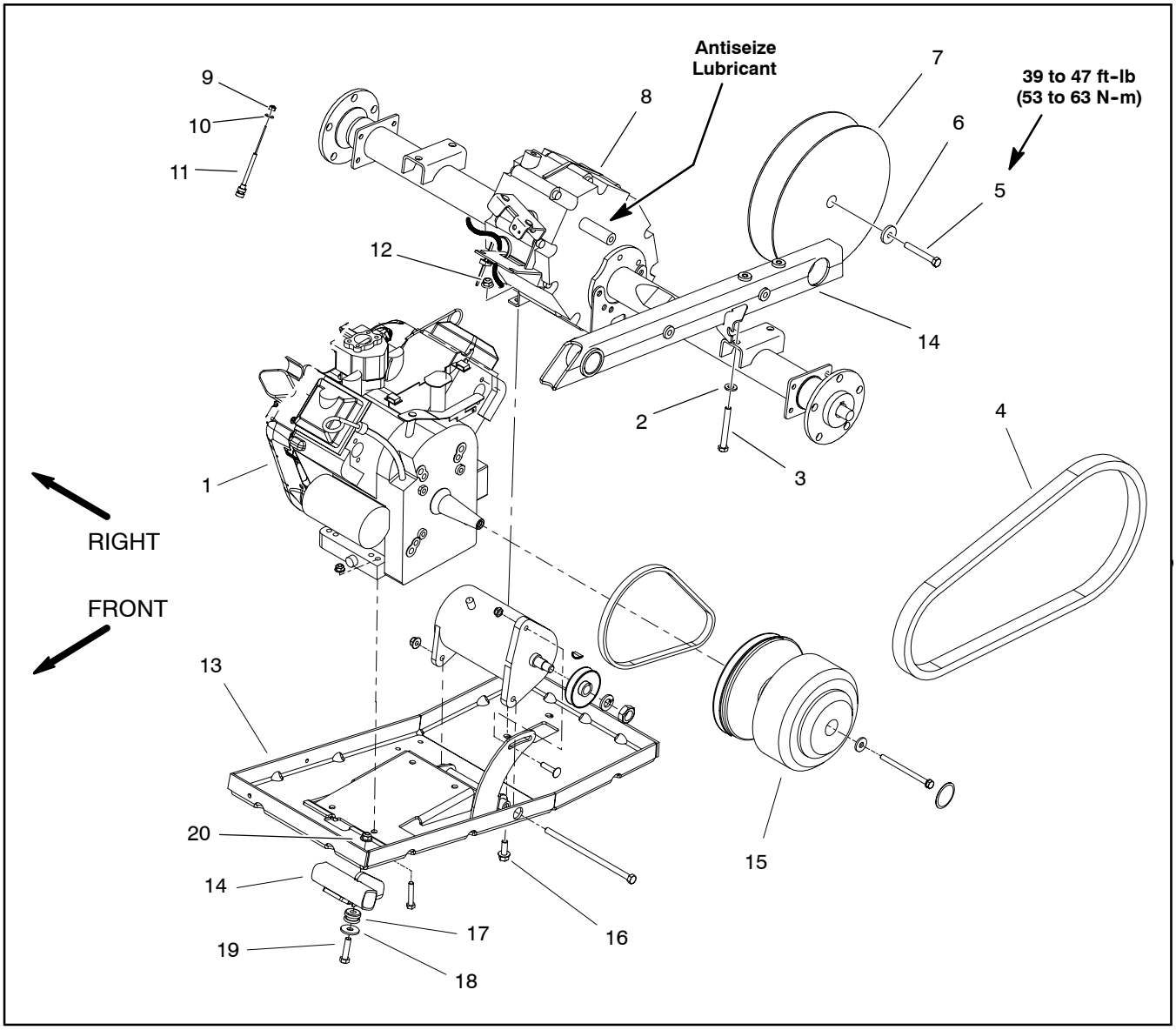


Figure 22

1. Engine
2. Washer (4 used)
3. Cap screw (4 used)
4. Drive belt
5. Cap screw
6. Stepped washer
7. Driven clutch
8. Transaxle
9. Lock nut
10. Flat washer
11. Shift cable (2 used)
12. Flange nut (4 used)
13. Engine tray
14. Swing arm
15. Drive clutch
16. Flange head screw (4 used)
17. Isolation mount (2 used)
18. Flat washer (2 used)
19. Cap screw (2 used)
20. Flange nut (2 used)

**Removal (Fig. 22)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Remove cargo box from the frame (see Cargo Box Removal in Chapter 7 – Chassis).

3. Remove drive belt from the driven clutch.

4. Remove cable ties that secure both battery cables to the passenger side axle tube.

5. Remove muffler from machine (see Exhaust System Removal in the Service and Repairs section of Engine Chapter).

6. On Workman MD, remove governor and cable brackets from the transaxle as follows (Fig. 23).

A. Scribe mark across governor bracket and governor shaft to help installation. Loosen both set screws securing the bracket to the shaft.

B. Remove both lock nuts securing the cable bracket to the transaxle case. Remove both brackets and cables as a complete assembly from the transaxle case and governor shaft.

7. Remove lock nut that secures the select lever assembly to the transaxle selector shaft (Fig. 24). Loosen jam nuts securing both shift cables to the cable bracket on the transaxle. Separate select lever and shift cables assembly from the transaxle.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.**

8. Jack up both sides of the frame enough to remove rear wheels.

A. Chock the front and rear of both front tires to prevent the vehicle from moving.

B. Support both sides of the frame with appropriate jack stands positioned just in front of the rear axle tubes. This will allow the transaxle to be removed from the vehicle.

9. Remove both rear wheels and brake assemblies from the transaxle (see Rear Wheel and Brake Removal in Chapter 7 – Chassis).

**CAUTION**

**When removing engine tray, make sure hoist can support the total weight of the engine, transaxle, engine tray and other attached components. Total weight is approximately 300 pounds (137 kg).**

10. Attach hoist to the engine tray to allow engine and transaxle to be lowered from the vehicle. Make sure hoist is attached to hold the full weight of the engine, transaxle and tray.

11. Remove both flange nuts (item 20), flat washers (item 18) and cap screws (item 19) that secure the engine tray to the swing arm.

12. Remove four (4) cap screws (item 3) and flat washers (item 2) that secure the transaxle to the swing arm.

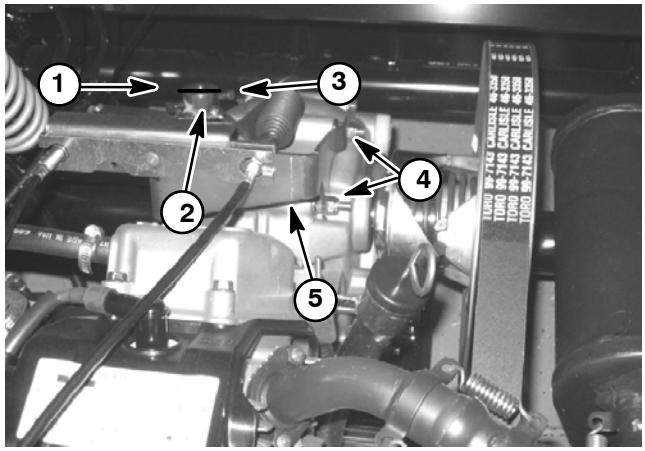


Figure 23

1. Scribe mark
2. Governor bracket
3. Set screw (2 used)
4. Lock nuts
5. Cable bracket

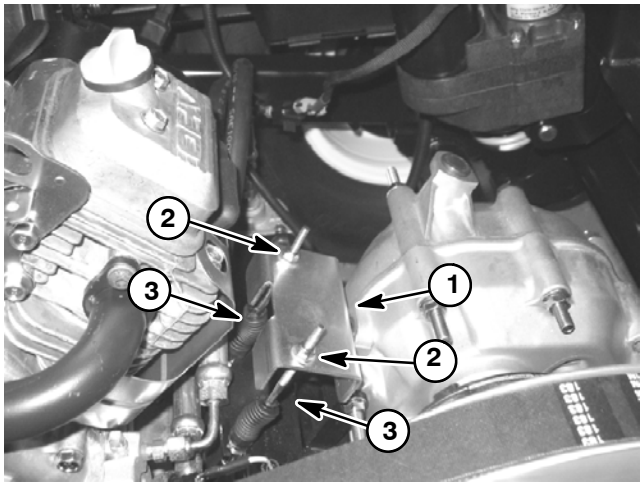


Figure 24

1. Select lever assembly
2. Lock nut location
3. Shift cable

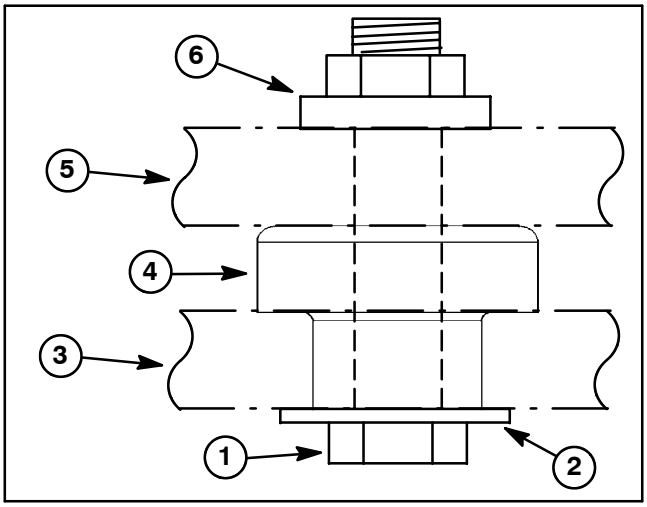


Figure 25

1. Cap screw
2. Flat washer
3. Swing arm bracket
4. Isolation mount
5. Engine tray
6. Flange nut

**IMPORTANT: Take care to not damage the engine, fuel hoses, electrical harness or other parts while lowering the engine tray assembly.**

13. Carefully move engine tray assembly toward the rear of the vehicle to clear mounts on swing arm. Then, lower engine tray enough to allow the transaxle and driven clutch to be removed from the rear of the vehicle. Support engine tray in this position to prevent it from shifting or falling.

14. Remove four (4) flange nuts (item 12) and flange head screws (item 16) that secure the transaxle to the engine tray.

15. Carefully remove transaxle assembly from the rear of the vehicle.

**Installation (Fig. 22)**

1. Position transaxle assembly to the engine tray. Secure transaxle to the tray with four (4) flange nuts (item 12) and flange head screws (item 16).

2. Make sure that isolation mounts (item 17) are positioned in the swing arm so that the flange is positioned between the swing arm bracket and engine tray location (Fig. 25).

**IMPORTANT: Take care to not damage the engine, fuel hoses, electrical harness or other parts while raising the engine tray assembly.**

3. Using hoist, carefully raise engine tray assembly and align it with swing arm mounting points.

4. Secure the transaxle to the swing arm with four (4) cap screws (item 3) and flat washers (item 2).

5. Secure engine tray to the swing arm:

   A. Align engine tray to swing arm. Insert cap screw with flat washer up through swing arm bracket, isolation mount and engine tray (Fig. 25).

   B. Secure cap screw with flange nut.

6. Position select lever assembly and shift cables to the transaxle (Fig. 24). Secure select lever assembly to the selector shaft with lock nut. Secure both shift cables to the cable bracket with jam nuts.

7. On Workman MD, secure governor and cable brackets to the transaxle as follows (Fig. 23).

   A. Position governor and cable brackets with cables as a complete unit to the transaxle case and governor shaft.

   B. Secure cable bracket to the transaxle case with both lock nuts.

   C. Align scribe marks on the governor bracket and shaft. Secure bracket to the shaft with both set screws.

8. Secure both battery cables to the passenger side axle tube with cable ties.

9. Install drive belt to the driven clutch.

10. Install muffler to machine (see Exhaust System Installation in the Service and Repairs section of Engine Chapter).

11. Install both brake assemblies and wheels to the transaxle (see Rear Wheel and Brake Installation in Chapter 7 – Chassis).

12. Install cargo box to the frame (see Cargo Box Installation in Chapter 7 – Chassis).

13. Verify proper ground speed (see Adjust Ground Speed in the Adjustments section of this chapter).

14. Check brakes for proper operation.

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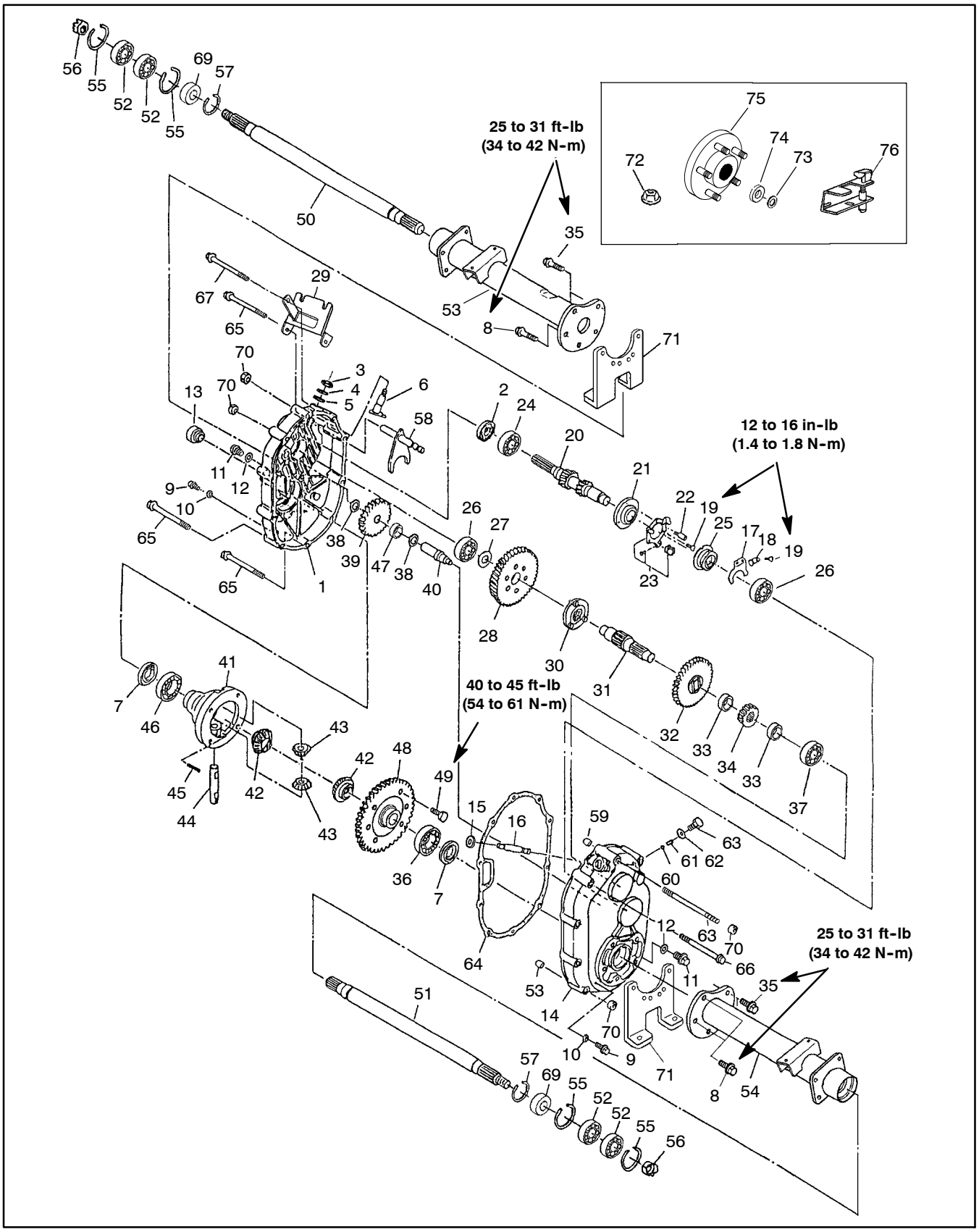
25 to 31 ft-lb
(34 to 42 N-m)
12 to 16 in-lb
(1.4 to 1.8 N-m)
40 to 45 ft-lb
(54 to 61 N-m)
25 to 31 ft-lb
(34 to 42 N-m)

Figure 26

Figure 26 (Continued)

1. Case (LH)
2. Oil seal
3. Oil seal
4. Snap ring
5. Spacer
6. Selector shaft
7. Oil seal (2 used)
8. Flange bolt (4 used)
9. Oil check plug (2 used)
10. Gasket (2 used)
11. Oil drain plug (2 used)
12. Gasket (2 used)
13. Oil filler plug
14. Case (RH)
15. Oil seal (if equipped)
16. Governor shaft (if equipped)
17. Governor fork (if equipped)
18. Stopper (if equipped)
19. Screw and washer (4 used)
20. Input shaft
21. Governor base (if equipped)
22. Lock pin (if equipped)
23. Governor plate unit (if equipped)
24. Ball bearing
25. Governor sleeve (if equipped)
26. Ball bearing (2 used)
27. Spacer
28. Gear 55
29. Cable bracket
30. Pin clutch
31. Center shaft
32. Gear 47
33. Collar (2 used)
34. Gear
35. Flange bolt (6 used)
36. Ball bearing
37. Ball bearing
38. Spacer (2 used)
39. Gear 34
40. Counter shaft
41. Differential case
42. Side gear (2 used)
43. Pinion gear (2 used)
44. Pinion shaft
45. Spring pin
46. Ball bearing
47. Needle bearing
48. Gear 62
49. Bolt (6 used)
50. Axle shaft (LH)
51. Axle shaft (RH)
52. Ball bearing (4 used)
53. Axle case (LH)
54. Axle case (RH)
55. Snap ring (4 used)
56. Castle nut (2 used)
57. Snap ring (2 used)
58. Shift shaft
59. Pipe knock (2 used)
60. Steel ball
61. Spring
62. Gasket
63. Bolt
64. Gasket
65. Flange bolt (6 used)
66. Flange bolt
67. Flange bolt
68. Bolt
69. Collar (2 used)
70. Flange nut (11 used)
71. Axle bracket (2 used)
72. Lock nut
73. Spring washer (2 used)
74. Washer (2 used)
75. Wheel hub assembly (2 used)
76. Select lever

### Transaxle Disassembly and Inspection

1. Disassemble case (LH and RH)

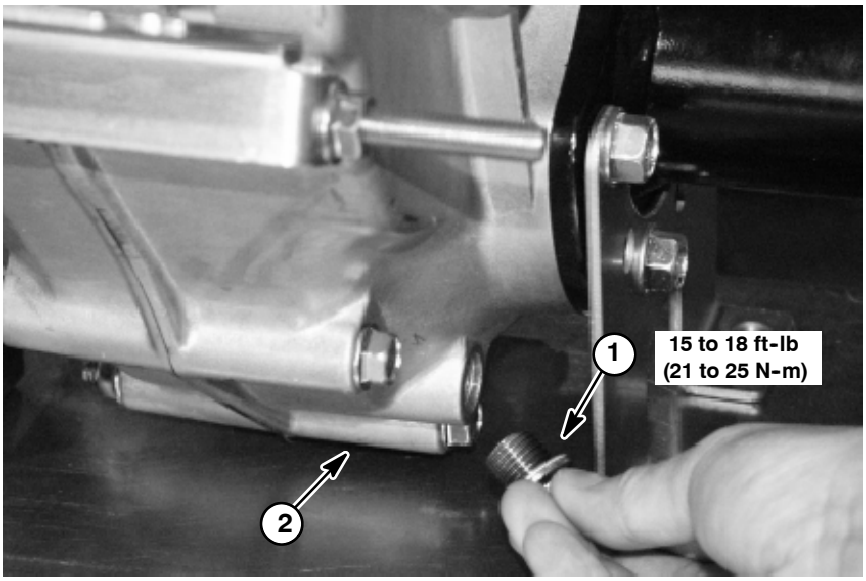


Figure 27

1. Drain plug & gasket
2. Case (LH)

**CAUTION**

**Make sure transaxle case is not hot prior to draining oil to prevent getting burned.**

A. Remove drain plug. Drain oil completely from transaxle. Replace drain plug gasket if damaged.

B. Reinstall drain plug to transaxle case. Torque plug from **15 to 18 ft-lb (21 to 25 N-m)**.

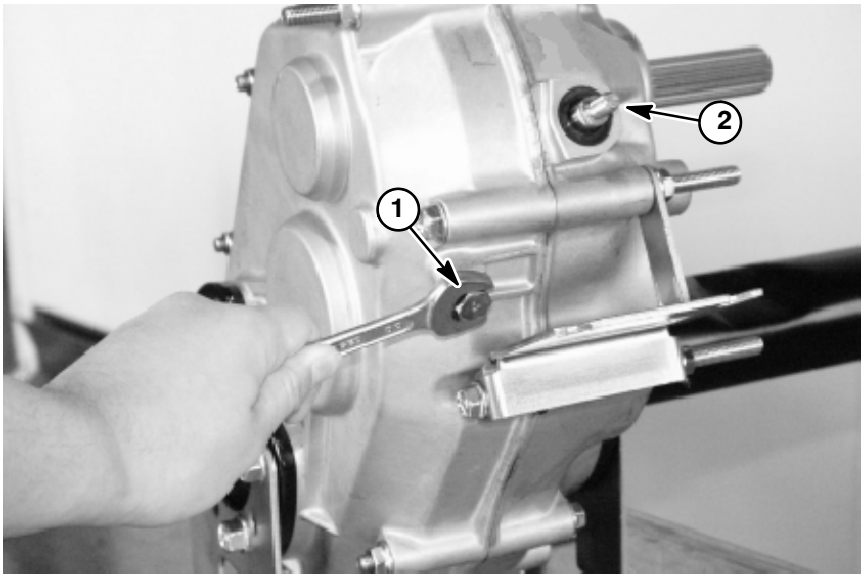


Figure 28

1. **Bolt (steel ball, spring & gasket)**
2. **Selector shaft**

C. Remove bolt near the selector shaft. Remove spring and steel ball. Replace gasket if damaged.

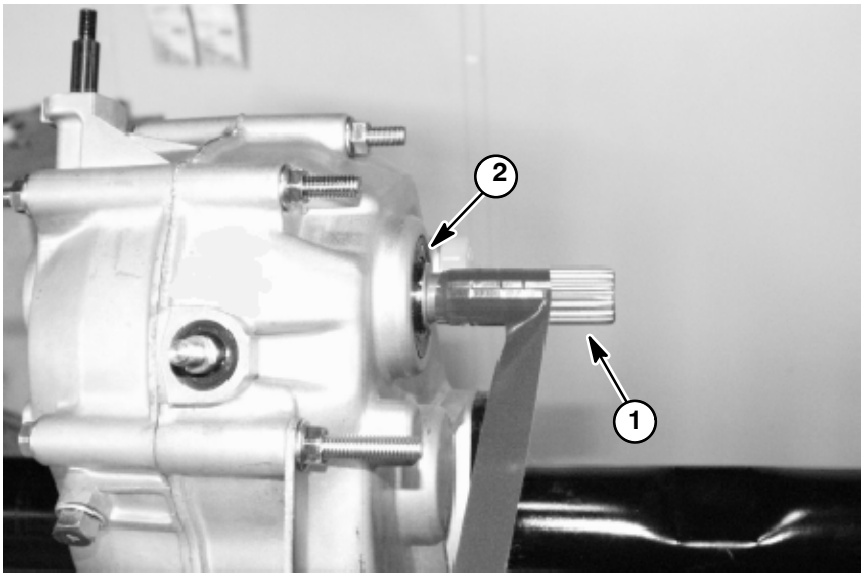


Figure 29

1. **Input shaft**
2. **Oil seal**

D. Wrap vinyl tape around the splined portion of the input shaft. This should protect the oil seal from being damaged.

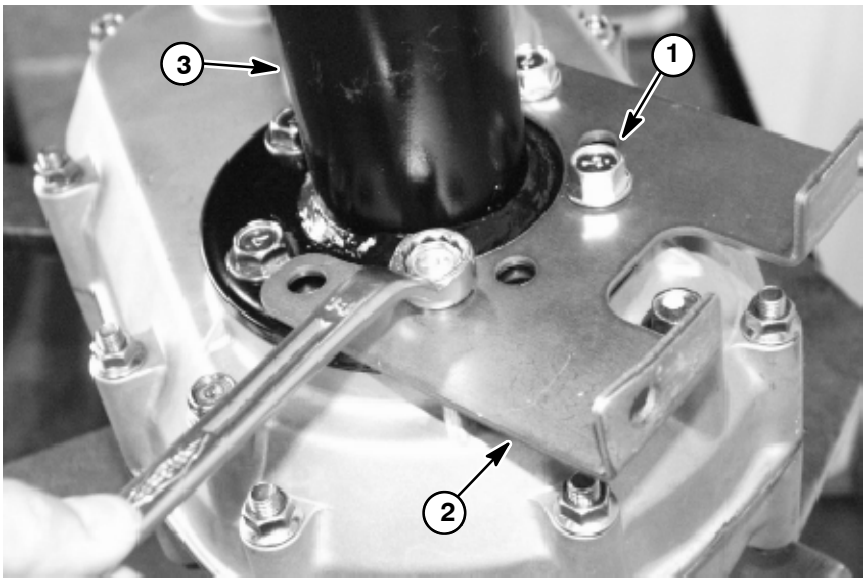


Figure 30

1. **Flange bolts (3 used)**
2. **Axle bracket**
3. **Axle case**

E. Remove three (3) flange bolts securing the axle bracket and axle case to each case. Separate bracket from each axle case.

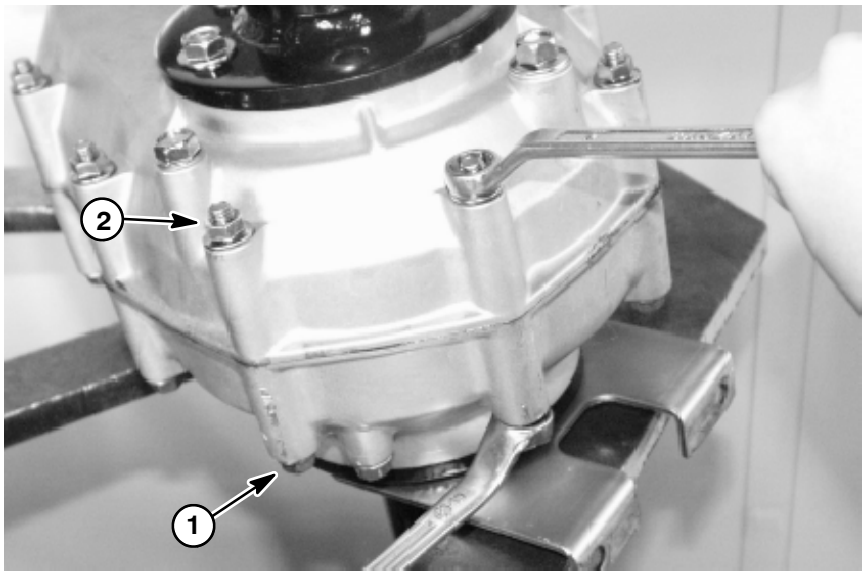


Figure 31

1. **Flange bolt (10 used)**
2. **Flange nut**

F. With the input shaft side down, loosen and remove flange bolts and nuts securing the case (RH) and case (LH) together.

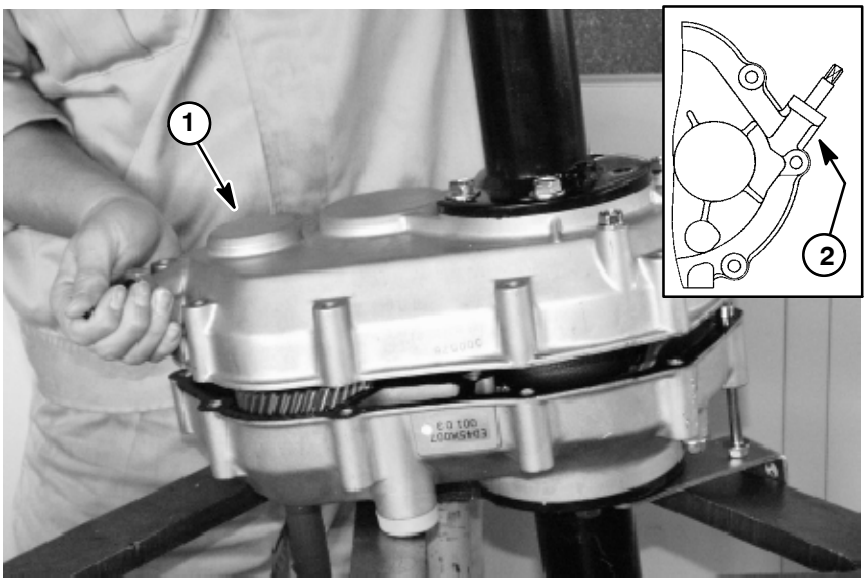


Figure 32

1. **Case (RH)**
2. **Governor boss**

**IMPORTANT: Make sure to not hit the governor boss too hard when separating the cases, the boss may get damaged. Do not pry open the two cases with a screw driver, damage may result to the sealing surfaces.**

G. Hold the case (RH) and lift up while lightly tapping the governor boss with a plastic hammer.

2. Remove input shaft, center shaft and differential assemblies.

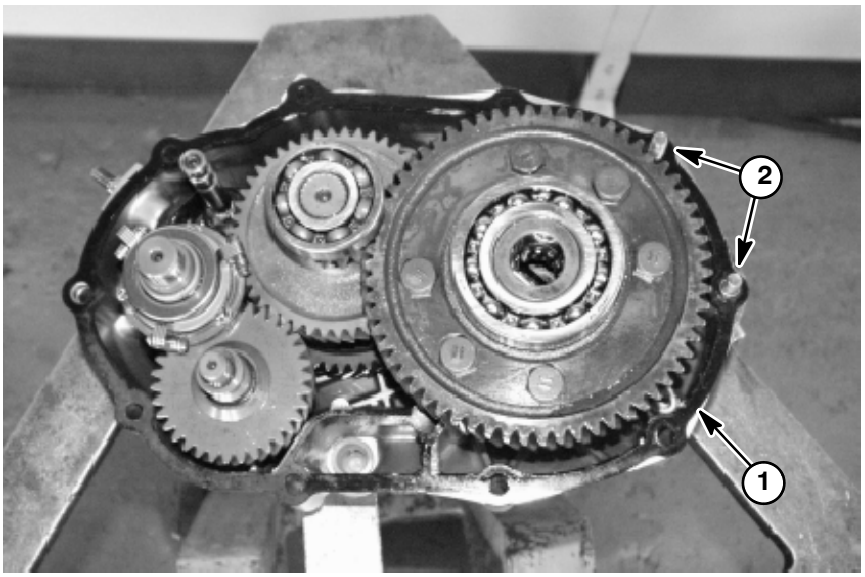


Figure 33

1. **Gasket**
2. **Pipe knock**

A. Remove gasket and pipe knocks.

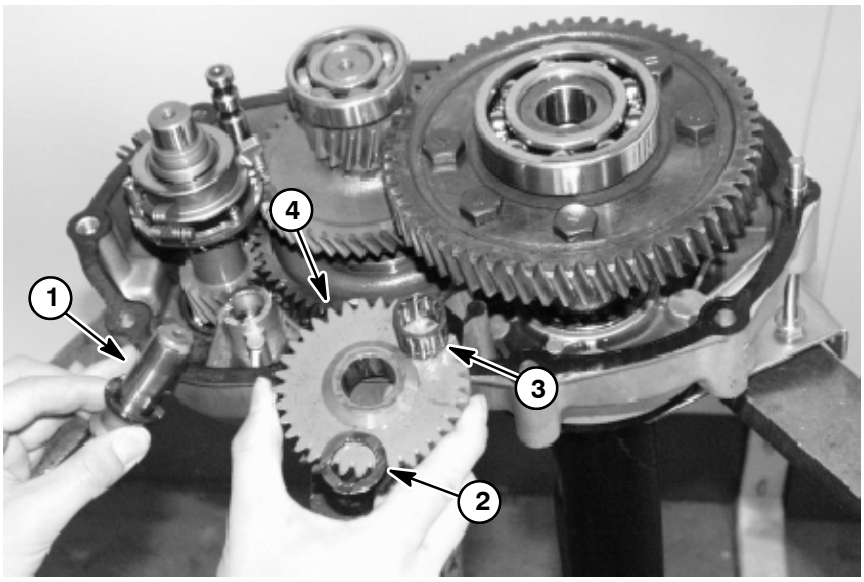


Figure 34

1. **Counter shaft**
2. **Spacer (2 used)**
3. **Needle bearing**
4. **Gear 34**

B. Pull out counter shaft. Remove spacer, needle bearing, gear 34 and spacer.

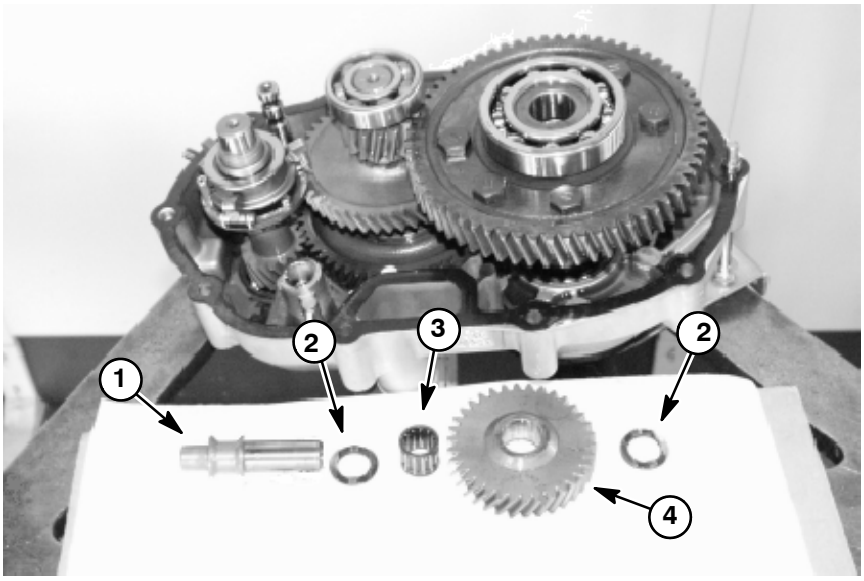


Figure 35

1. **Counter shaft**
2. **Spacer (2 used)**
3. **Needle bearing**
4. **Gear 34**

C. Replace counter shaft if it has abnormal wear, cracks or damage.

D. Replace spacer if either one is cracked or bent.

E. Replace needle bearing if needles are bent, do not rotate freely or do not remain in the bearing cage.

F. Replace gear 34 if worn or damaged. Cracked, broken, missing or chipped gear teeth are not acceptable.

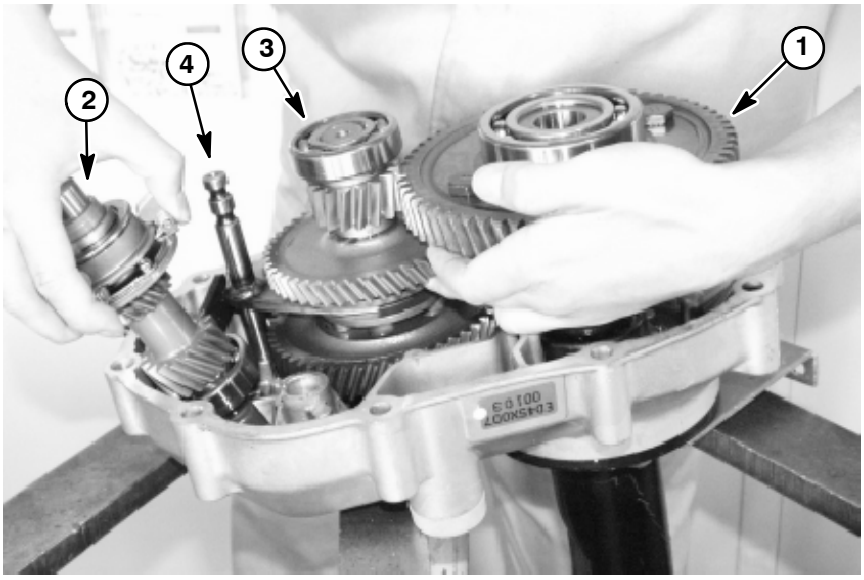


Figure 36

1. **Differential assembly**
2. **Input shaft assembly**
3. **Center shaft assembly**
4. **Shift shaft**

**IMPORTANT: Make sure not to damage the oil seal when removing the input shaft.**

**NOTE:** If any of the assemblies can not be pulled out by hand, hold the assembly while gently tapping the case with a plastic hammer. Make sure to tap equally around the case.

3. Remove axle case from case (RH and LH).

G. Lift up differential assembly, center shaft assembly and input shaft assembly at the same time. First, remove input shaft assembly. Then, remove center shaft assembly with the shift shaft and differential assembly.

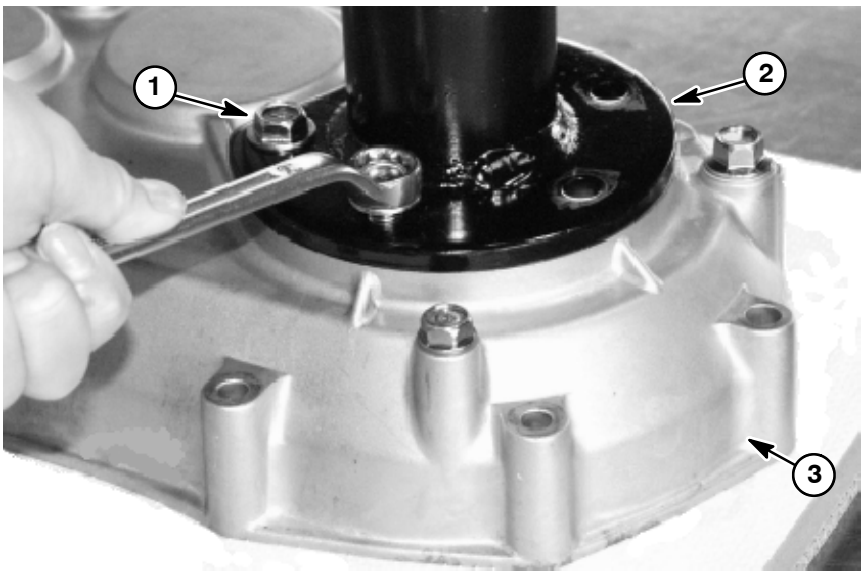


Figure 37

1. **Flange bolt**
2. **Axle case**
3. **Transaxle case**

A. Remove remaining two (2) flange bolts securing each axle case to the case. Remove axle case from the transaxle case.

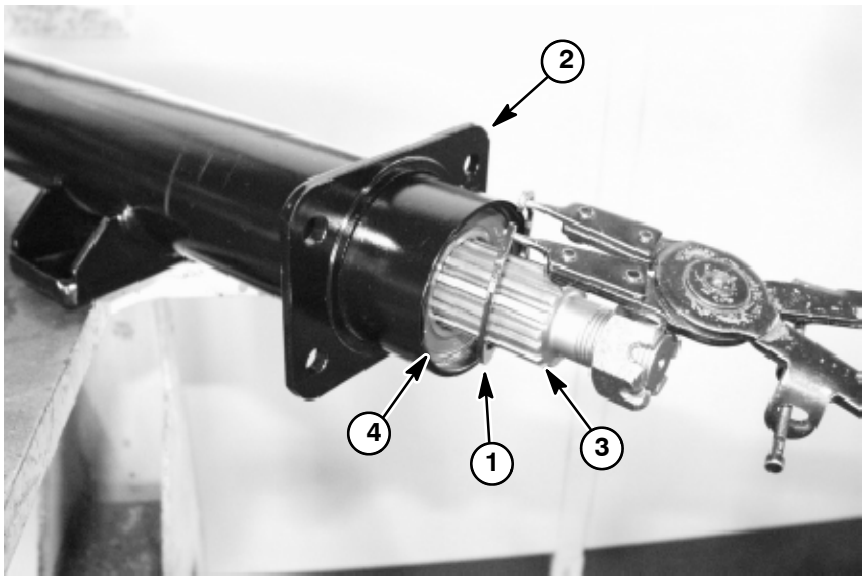


Figure 38

1. Snap ring
2. Axle case
3. Axle shaft
4. Ball bearing

**IMPORTANT: Do not reuse snap ring. Discard and replace ring with new one.**

B. Remove snap ring from the axle case. Remove axle shaft from case.

**IMPORTANT: When replacing ball bearings, both ball bearings must be replaced as a set.**

4. Disassemble input shaft assembly.

C. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

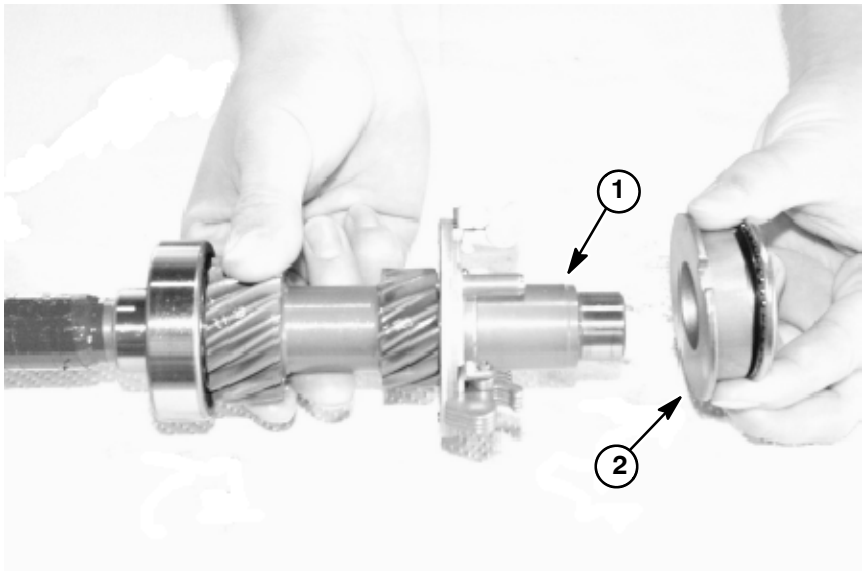


Figure 39

1. Input shaft
2. Governor sleeve (Workman MD)

A. On Workman MD, remove governor sleeve from the input shaft.

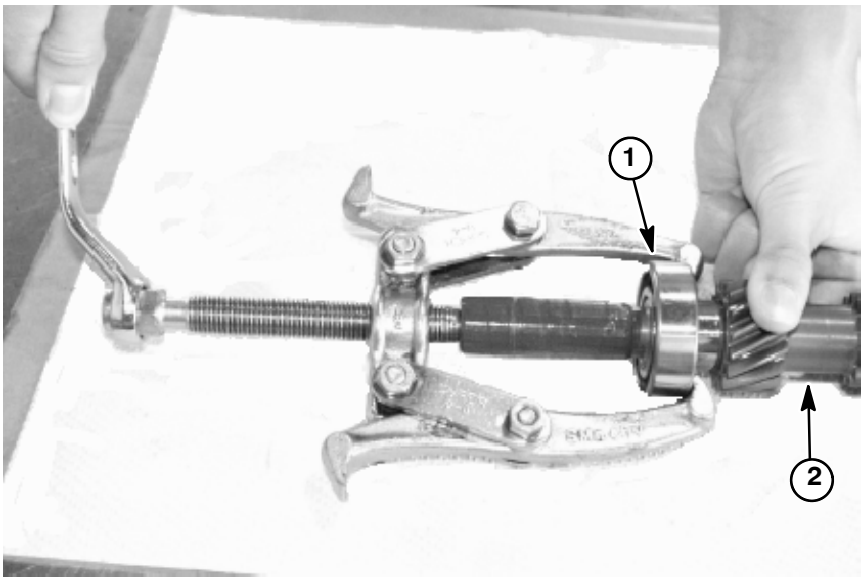


Figure 40

1. **Ball bearing**
2. **Input shaft**

**IMPORTANT: Do not reuse ball bearings that have been removed.**

B. Remove ball bearing from the input shaft with a bearing puller.

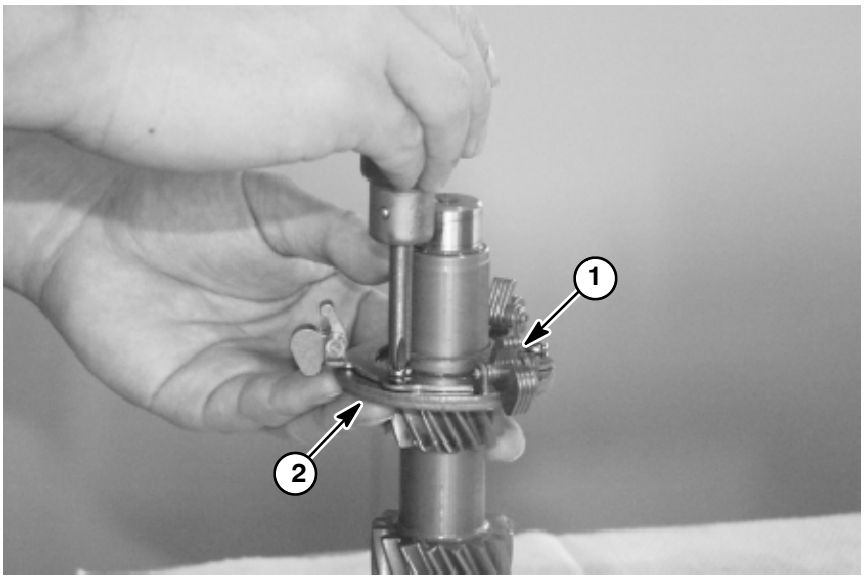


Figure 41

1. **Governor plate assembly**
2. **Governor base**

**IMPORTANT: Make sure to not damage the screw heads when removing screws. Each screw is secured with an adhesive.**

C. On Workman MD, remove two (2) screws and lock pin securing the governor plate assembly to the governor base.

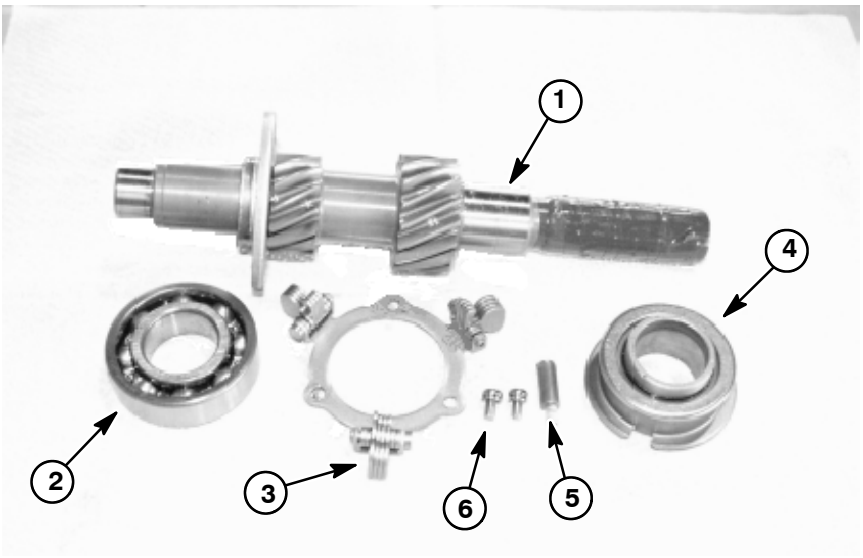


Figure 42

1. **Input shaft**
2. **Ball bearing**
3. **Governor plate (weight) (WM MD)**
4. **Governor sleeve (Workman MD)**
5. **Lock pin (Workman MD)**
6. **Screw (2 used) (Workman MD)**

D. Replace input shaft if worn or damaged. Gear teeth that are cracked, broken, chipped or missing are not acceptable.

E. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

F. On Workman MD, replace governor plate if cracked, bent or any weight is missing. Weights must swing freely.

G. On Workman MD, replace governor sleeve if cracked or worn.

5. Disassemble center shaft assembly.

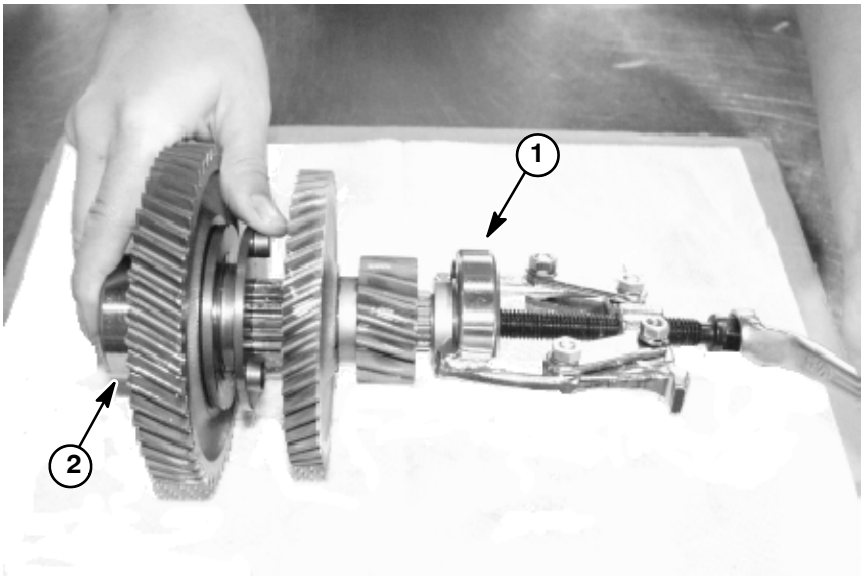


Figure 43

1. **Ball bearing**
2. **Ball bearing**

**IMPORTANT: Do not reuse ball bearings that have been removed.**

A. Remove ball bearings from the center shaft assembly. Discard removed bearings.

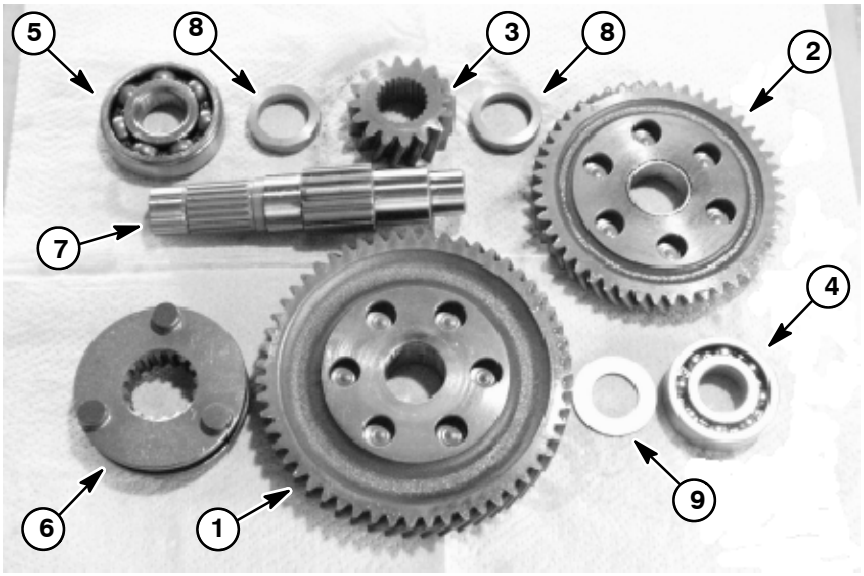


Figure 44

1. **Gear 55**
2. **Gear 47**
3. **Gear (small)**
4. **Ball bearing**
5. **Ball bearing**
6. **Pin clutch**
7. **Center shaft**
8. **Collar (2 used)**
9. **Spacer**

B. Remove gears, pin clutch, collars and spacer from the input shaft.

C. Replace gears if worn or damaged. Cracked, broken, missing or chipped gear teeth are not acceptable.

D. Replace center shaft if worn or damaged. Splines that are cracked, broken, chipped or missing are not acceptable.

E. Replace pin clutch if cracked or bent.

F. Replace collars or spacer if excessively worn or damaged. Replace both collars as a set.

6. Disassemble differential case assembly.

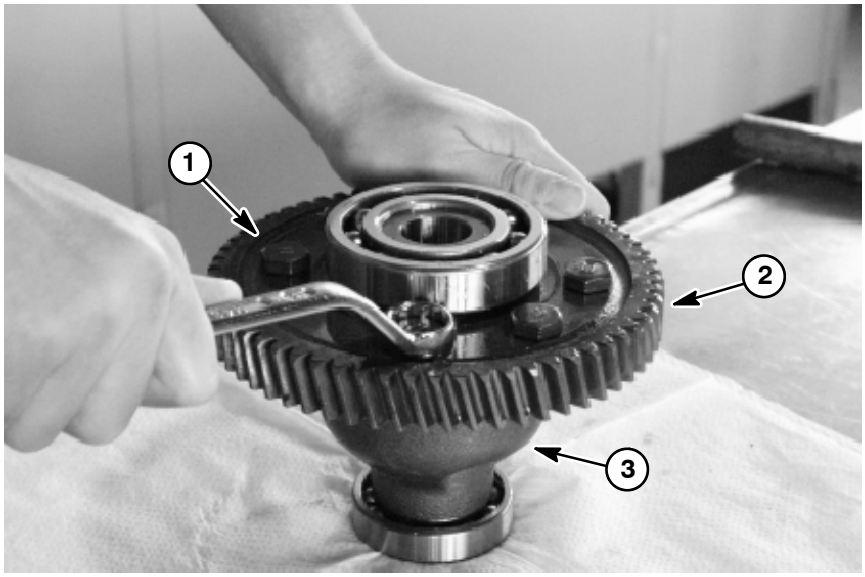


Figure 45

1. **Bolt (6 used)**
2. **Gear 62**
3. **Differential case**

A. Remove six (6) bolts securing gear 62 to the differential case.

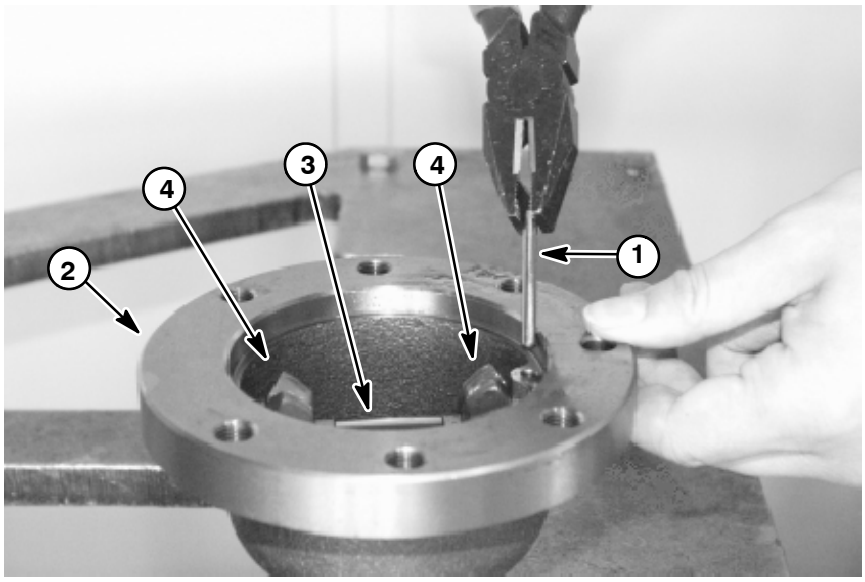


Figure 46

1. **Spring pin**
2. **Differential case**
3. **Pinion shaft**
4. **Pinion gear**

**NOTE:** The spring pin can be punched out from the hole on the opposite side of gear 62.

B. Remove spring pin from the differential case. Discard pin and replace it with new spring pin.

C. Remove pinion shaft and gears from the case. Separate gears from shaft.

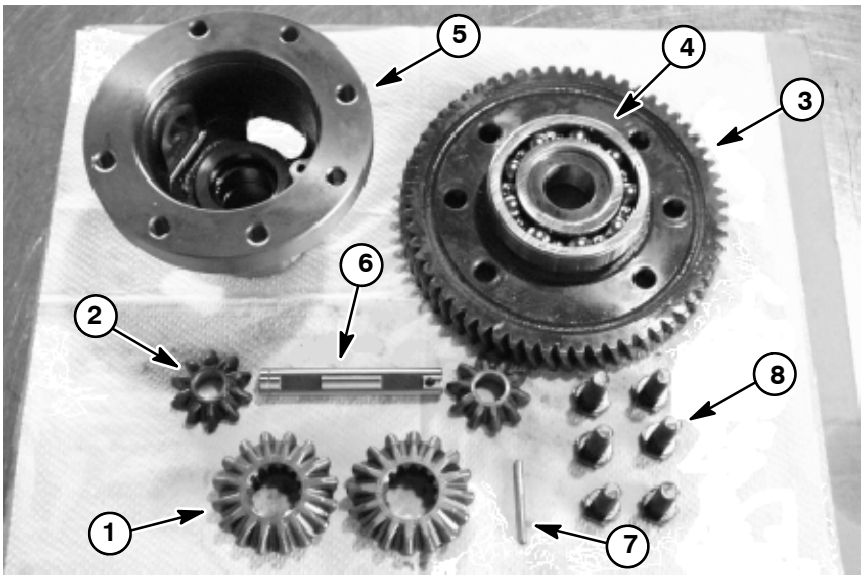


Figure 47

1. **Side gear (2 used)**
2. **Pinion gear (2 used)**
3. **Gear 34**
4. **Ball bearing**
5. **Differential case**
6. **Pinion shaft**
7. **Spring pin**
8. **Bolt (6 used)**

D. Replace gears if worn or damaged. Cracked, broken, missing or chipped gear teeth are not acceptable.

E. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

F. Replace case if machined areas where the side and pinion gears mesh are scored or if the pinion shaft fits loosely in its bore.

G. Replace pinion shaft if cracked or bent.

H. Replace oil seal if cracked, nicked or distorted such that it would not hold a proper seal.

7. On Workman MD, disassemble governor fork and shaft.

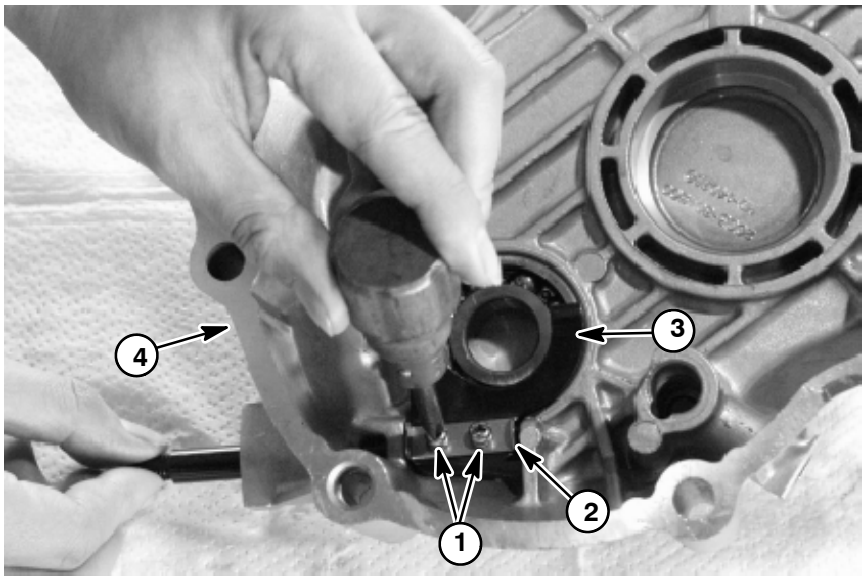


Figure 48

1. Screw (2 used)
2. Stopper
3. Governor fork
4. Case (RH)

**IMPORTANT: Make sure to not damage the screw heads when removing screws. Each screw is secured with an adhesive.**

A. Remove both screws and washers securing the stopper and governor fork to the case (RH). Remove stopper and fork from the case.

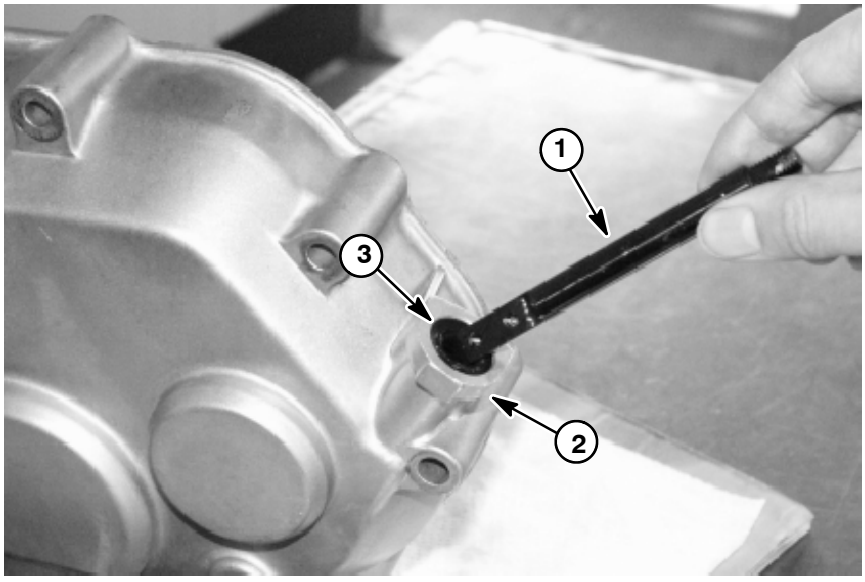


Figure 49

1. Governor shaft
2. Boss
3. Oil seal

**IMPORTANT: Make sure to not damage the oil seal when removing the governor shaft from the governor boss.**

B. Carefully pull governor shaft from the boss.

C. Replace oil seal if cracked, nicked or distorted such that it would not hold a proper seal.

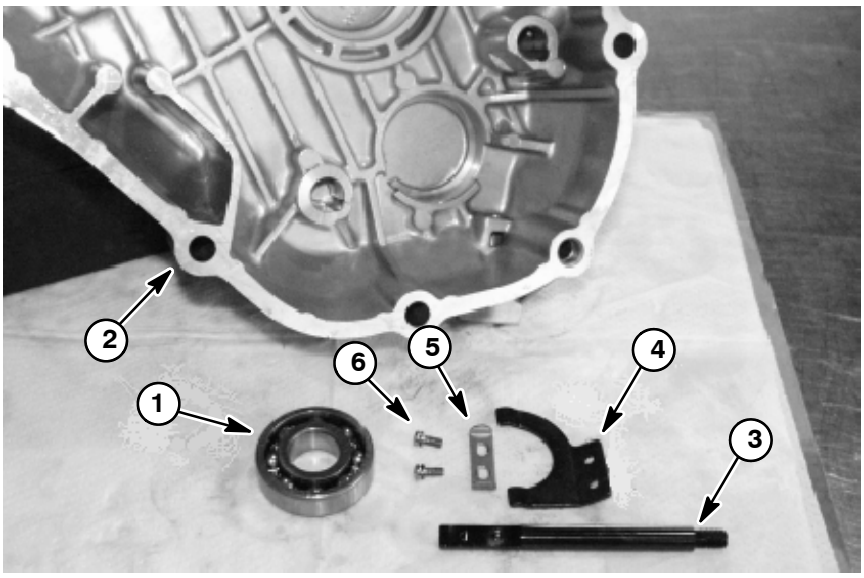


Figure 50

1. **Ball bearing**
2. **Case (RH)**
3. **Governor shaft**
4. **Governor fork**
5. **Stopper**
6. **Screw (2 used)**

D. Remove ball bearing from the case. Ball bearing roller balls must be free of deformation and scoring. Ball bearing must spin freely and have minimum axial play. Replace ball bearing as necessary.

E. Replace governor shaft if cracked, bent or excessively worn.

F. Replace governor fork or stopper if bent or deformed.

**Transaxle Assembly**

1. Assemble input shaft assembly.

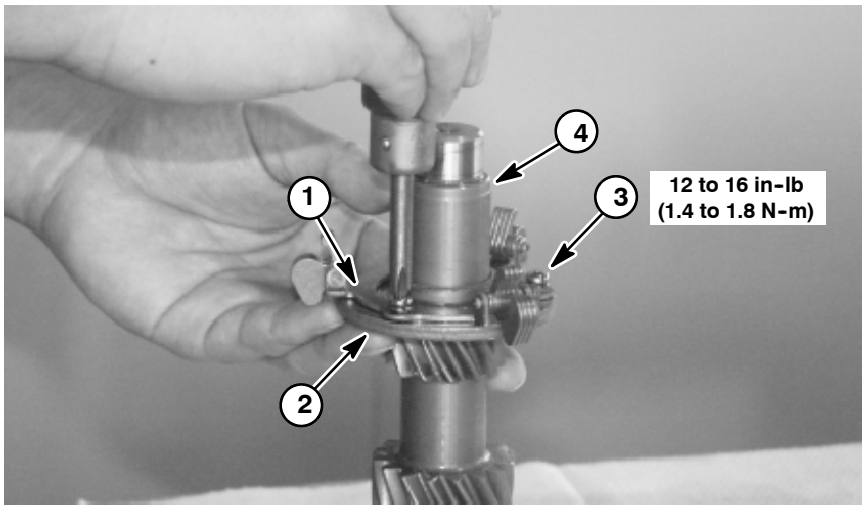


Figure 51

1. Governor plate
2. Governor base
3. Screw
4. Governor sleeve

**IMPORTANT: To prevent the screws that secure the governor plate to the governor from loosening, apply Loctite #242 (or equivalent) to the screw threads.**

A. On Workman MD, secure governor plate unit to the governor base with two (2) screws and lock pin. Torque fasteners from **12 to 16 in-lb (1.4 to 1.8 N-m)**.

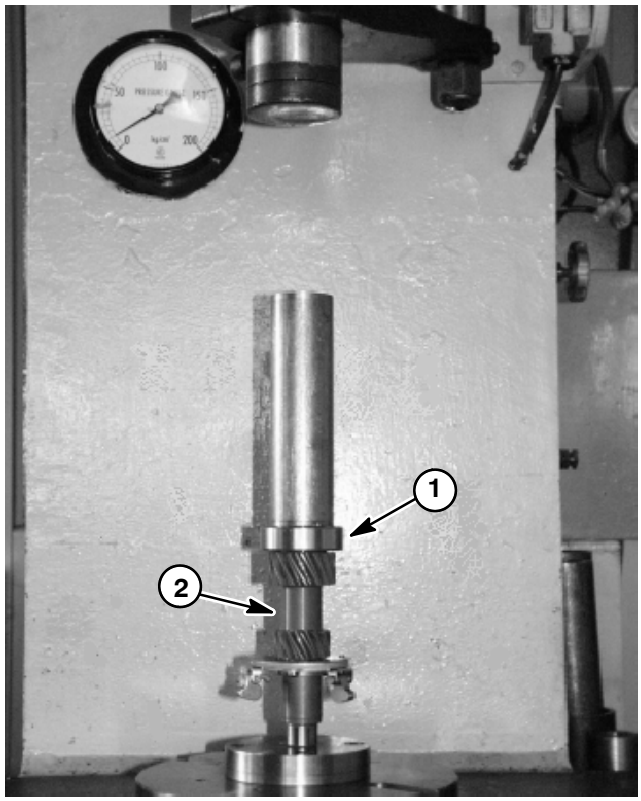


Figure 52

1. Ball bearing
2. Input shaft

**IMPORTANT: Make sure to press ball bearing at the inner race to prevent damaging the ball bearing.**

B. Press ball bearing onto the input shaft.

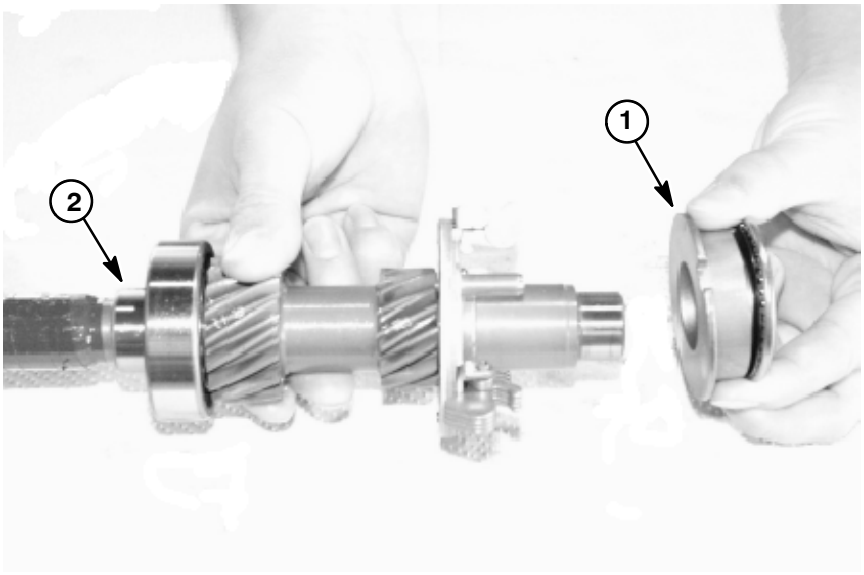


Figure 53

1. **Governor sleeve**
2. **Input shaft**

C. On Workman MD, apply molybdenum disulfide grease to the inside of the governor sleeve. Slide sleeve onto the input shaft. Make sure to engage sleeve slot with lock pin.

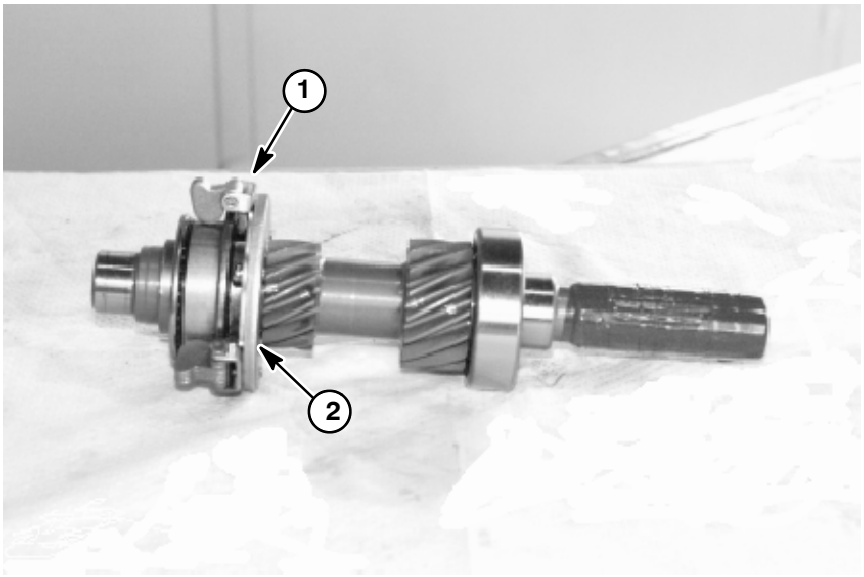


Figure 54

1. **Pivot point**
2. **Governor plate**

D. On Workman MD, make sure to apply molybdenum disulfide grease to the pivot points of the weights on the governor plate unit.

2. Assemble the center shaft assembly.

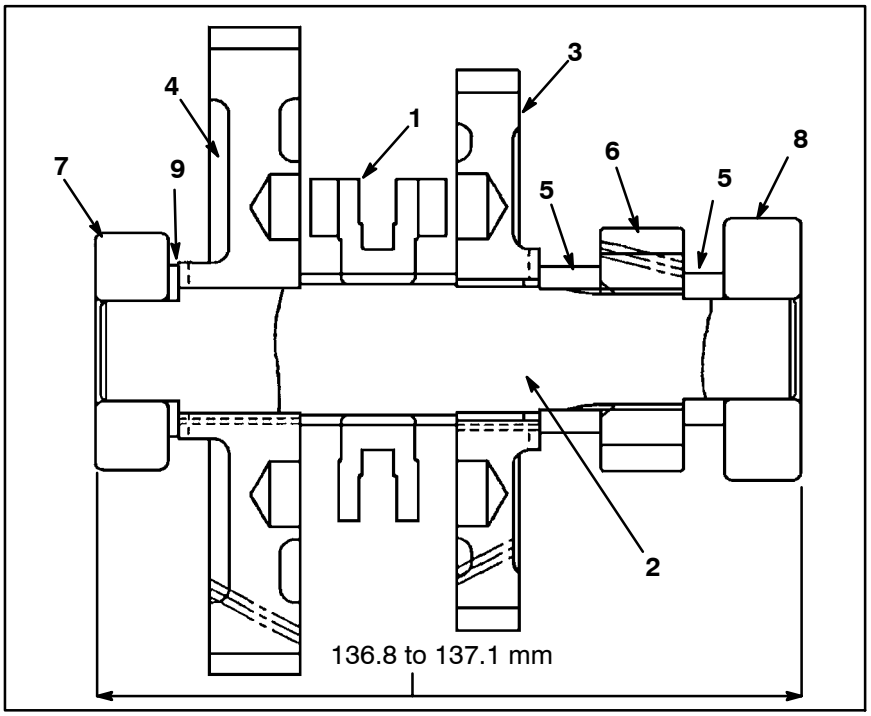


Figure 55

1. **Pin clutch**
2. **Center shaft**
3. **Gear 47**
4. **Gear 55**
5. **Collar**
6. **Gear (small)**
7. **Bearing**
8. **Bearing**
9. **Spacer**

**NOTE:** Before assembling, apply molybdenum disulfide grease to the inside of gears 47 and 55.

A. Slide pin clutch onto the centershaft. Install gears 47 and 55 onto shaft noting correct orientation of gears. Slide collars, small gear and spacer onto the center shaft.

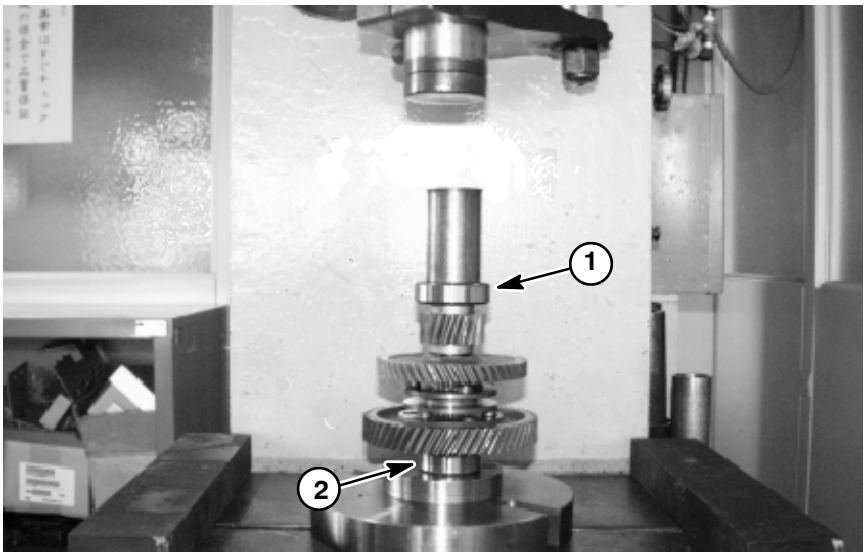


Figure 56

1. **Ball bearing**
2. **Ball bearing**

B. Press ball bearings onto the center shaft using a bearing press.

C. Make sure distance from one ball bearing outer edge to the other ball bearing outer edge is 136.8 to 137.1 mm (Fig. 55).

Figure 57

D. The center shaft should appear as above when assembled.

3. Assemble differential assembly.

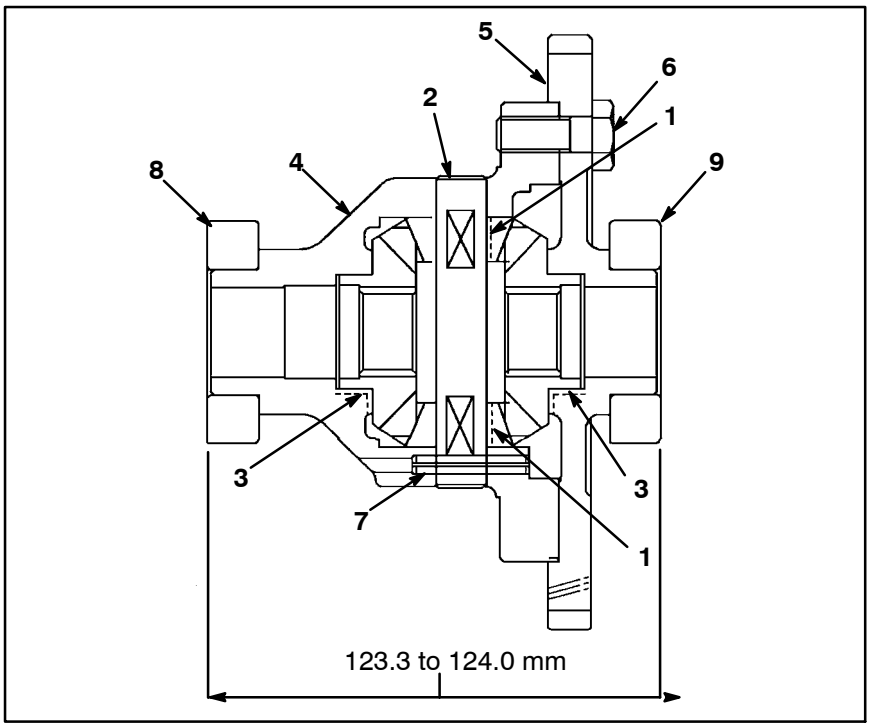


Figure 58

1. **Pinion gear (greased surface)**
2. **Pinion shaft**
3. **Side gear (greased surface)**
4. **Differential case**
5. **Gear 62**
6. **Bolt**
7. **Spring pin**
8. **Ball bearing**
9. **Ball bearing**

A. Apply molybdenum disulfide grease to the inside of both pinion gears where they contact the pinion shaft. Apply molybdenum disulfide grease to the outside of both side gears where they contact the differential case and gear 62.

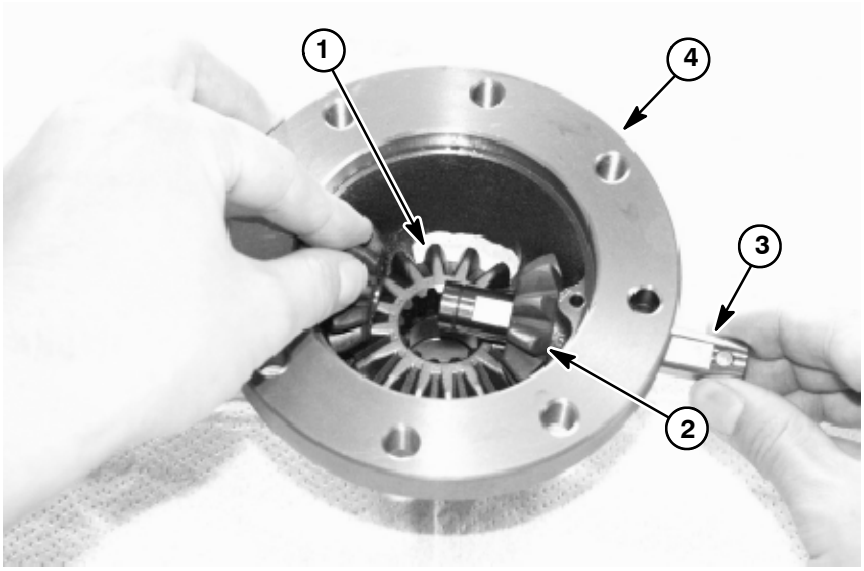


Figure 59

1. **Side gear**
2. **Pinion gear**
3. **Pinion shaft**
4. **Differential case**

B. Install side gear, both pinion gears and pinion shaft into the differential case.

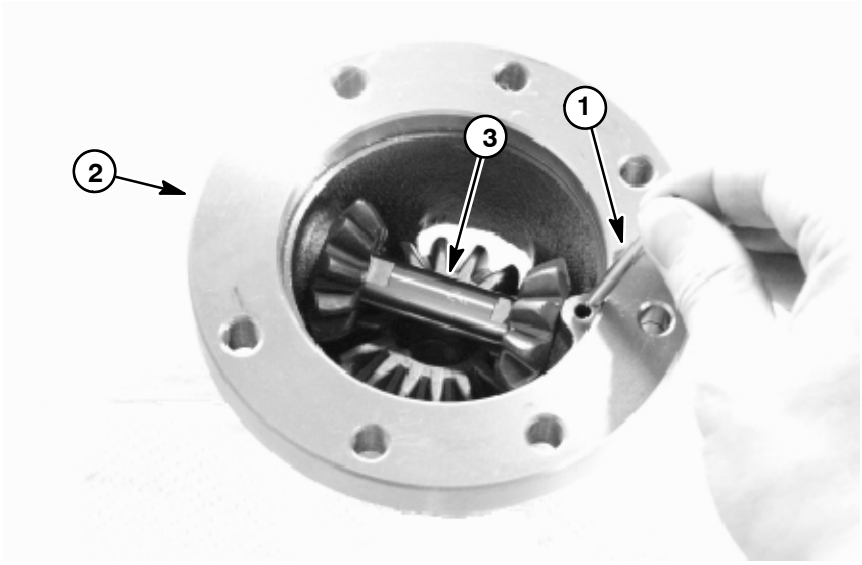


Figure 60

1. **Spring pin**
2. **Differential case**
3. **Pinion shaft**

C. Align pinion shaft hole and install new spring pin through the differential case and pinion shaft.

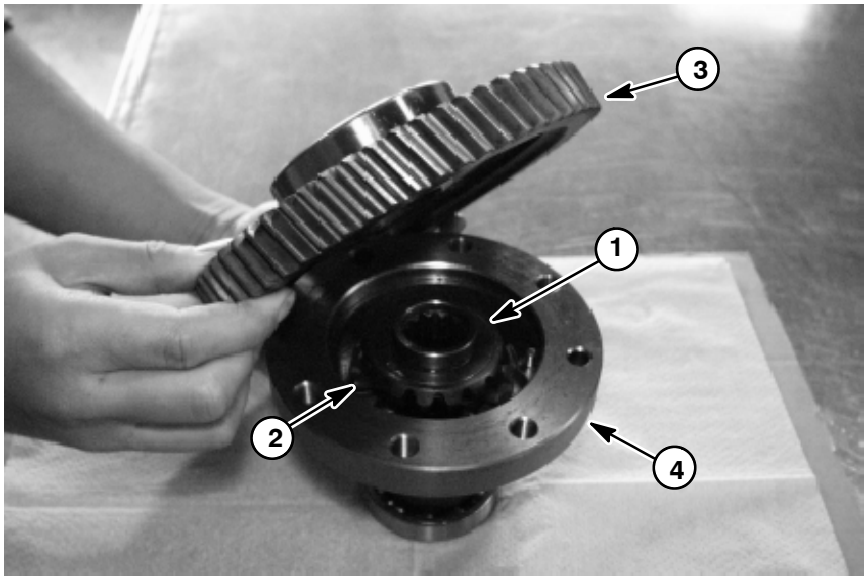


Figure 61

1. **Side gear**
2. **Pinion gear**
3. **Gear 62**
4. **Differential case**

D. Install remaining side gear to the pinion gears.

E. Secure gear 62 to the differential case with six (6) bolts. Torque bolts in a crossing pattern from **40 to 45 ft-lb (54 to 61 N-m)**.

Figure 62

**IMPORTANT: The length from the outer most side of each ball bearing must be from 123.3 to 124.0 mm (Fig. 58).**

F. If ball bearings were removed, press new ball bearings onto differential case and gear 62.

G. The differential assembly should appear as above when assembled.

4. On Workman MD, assemble governor fork.

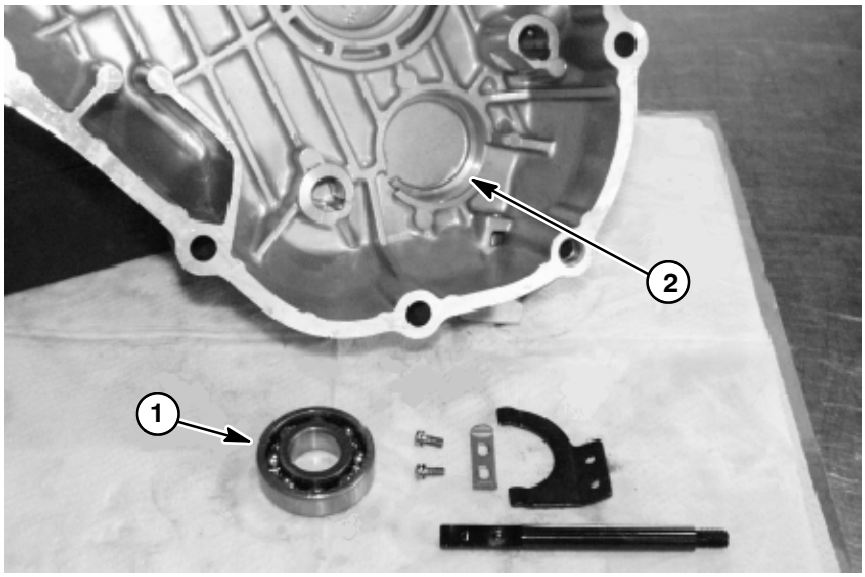


Figure 63

1. **Ball bearing**
2. **RH case (bearing bore)**

A. Install ball bearing into the bore of the case (RH).

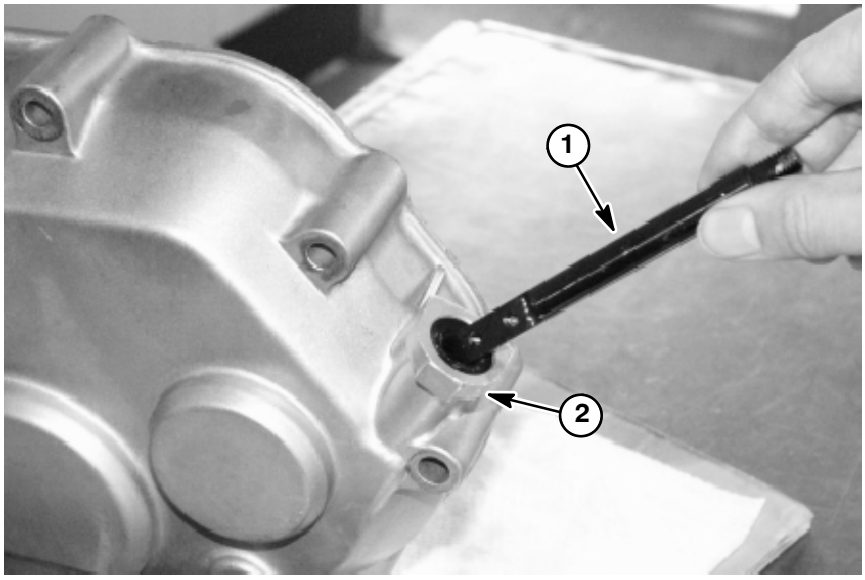


Figure 64

1. **Governor shaft**
2. **Boss**

**IMPORTANT: Make sure to not damage the oil seal when installing the governor shaft into the governor boss.**

B. Lubricate governor shaft with molybdenum disulfide grease before installing.

C. Install governor shaft into the boss.

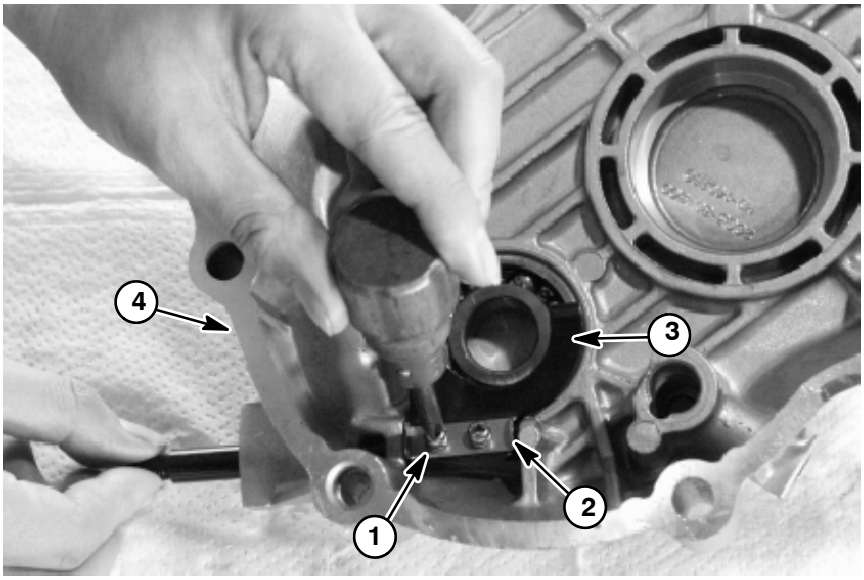


Figure 65

1. Screw (2 used)
2. Stopper
3. Governor fork
4. Case (RH)

**IMPORTANT: To prevent the screws that secure the governor fork and stopper to the governor shaft from loosening, apply Loctite #242 (or equivalent) to the screw threads.**

D. Secure stopper and governor fork to the governor shaft with both screws.

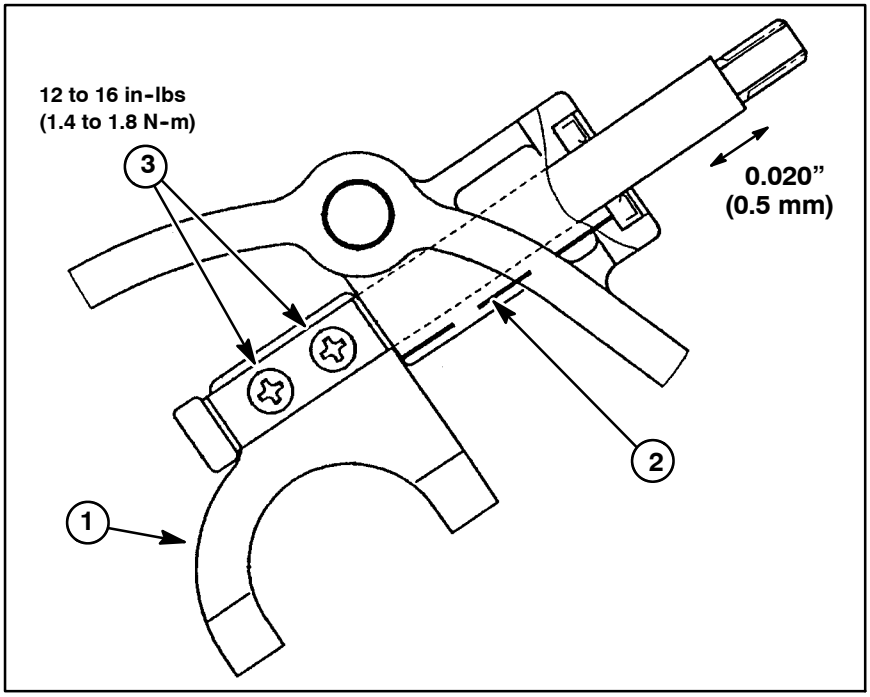


Figure 66

1. Governor fork
2. Governor shaft (greased surface)
3. Screw (2 used)

E. Adjust governor fork center to the center of the ball bearing hole. Also, adjust thrust clearance of the governor shaft to less than 0.020” (0.5 mm).

F. Torque screws from **12 to 16 in-lbs (1.4 to 1.8 N-m)**.

5. Install axle case to case (RH and LH).

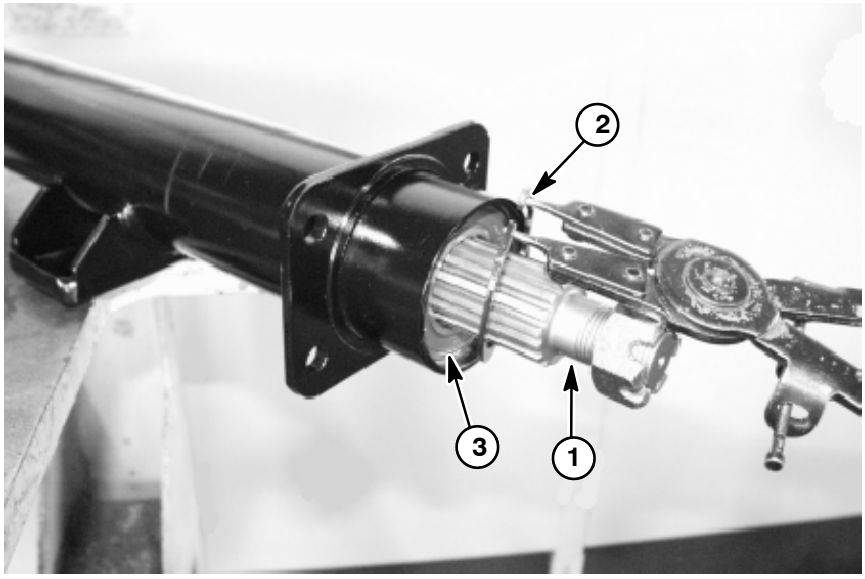


Figure 67

1. Axle shaft
2. Snap ring
3. Ball bearing

**IMPORTANT: Do not reuse snap ring. Replace snap ring with new one.**

A. Insert axle shaft with snap rings, collar and ball bearings into the axle case. Install snap ring to the axle case.

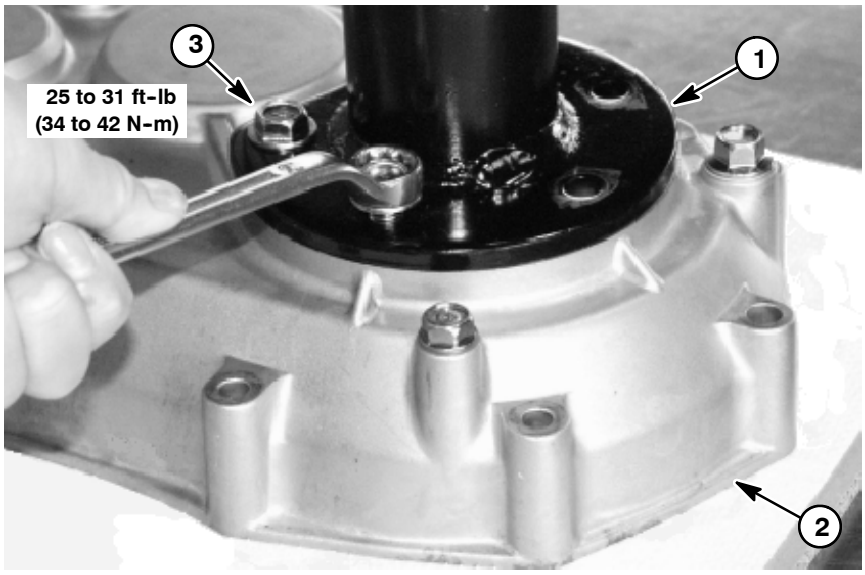


Figure 68

1. Axle case
2. Case
3. Flange bolt

**IMPORTANT: Make sure to install the axle case to the proper side of the case. The right side of the case takes the short axle case, and the left side takes the long axle case.**

**IMPORTANT: Make sure to not damage the oil seal when installing the axle case to the case.**

B. Install axle case to the case. Secure each axle case to the case with flange bolts. Torque bolts from **25 to 31 ft-lb (34 to 42 N-m)**.

6. Install input shaft, center shaft and differential assemblies to the case.

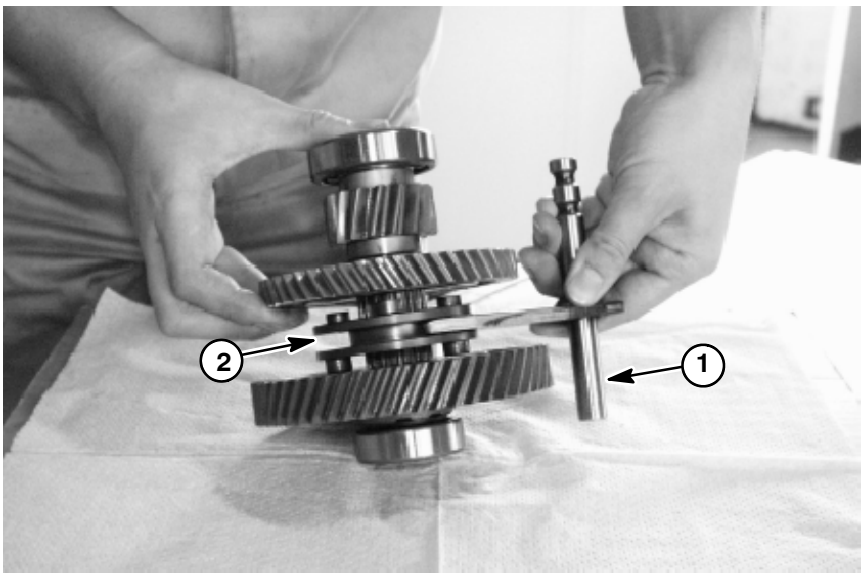


Figure 69

1. **Shift shaft**
2. **Clutch groove**

A. Insert fork of the shift shaft to the clutch groove of the center shaft assembly.

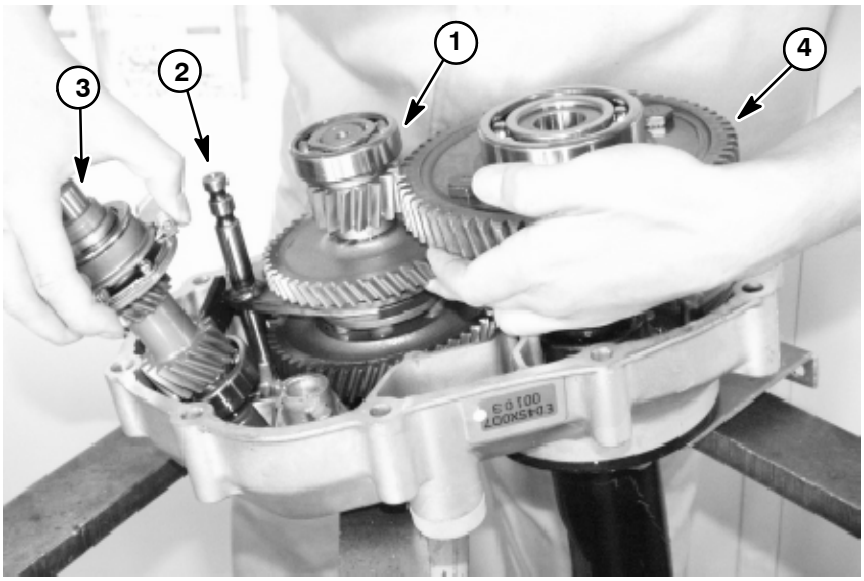


Figure 70

1. **Center shaft assembly**
2. **Shift shaft**
3. **Input shaft**
4. **Differential assembly**

B. Replace oil seals for the input and selector shafts on the case (LH) if cracked, nicked or distorted such that they would not hold a proper seal.

**IMPORTANT: Make sure to not damage the oil seal when installing the input shaft.**

C. Install center shaft assembly with shift shaft and differential assembly. Then, install input shaft assembly. Lower differential assembly, center shaft assembly and input shaft assembly into the case at the same time.

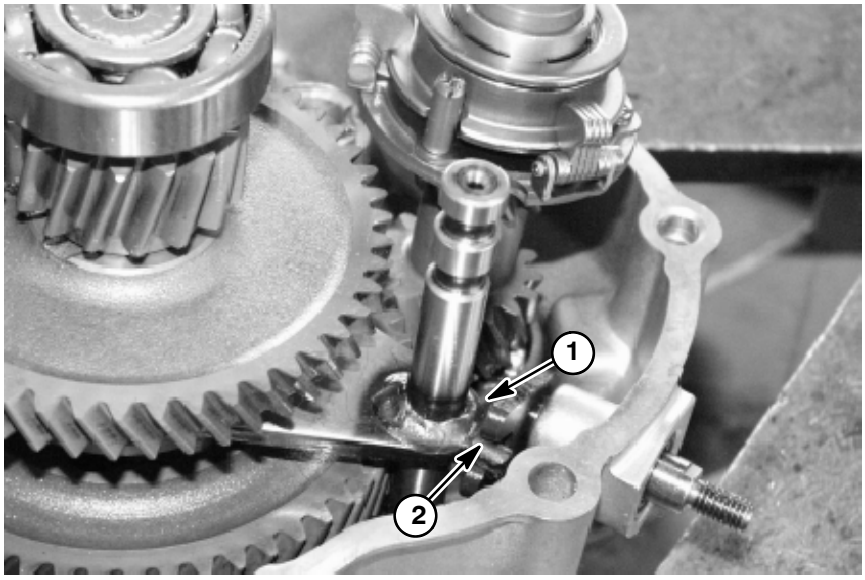


Figure 71

1. **Fork (selector shaft)**
2. **Pin (shift shaft)**

D. Make sure the selector shaft fork is contacting the pin on the shift shaft.

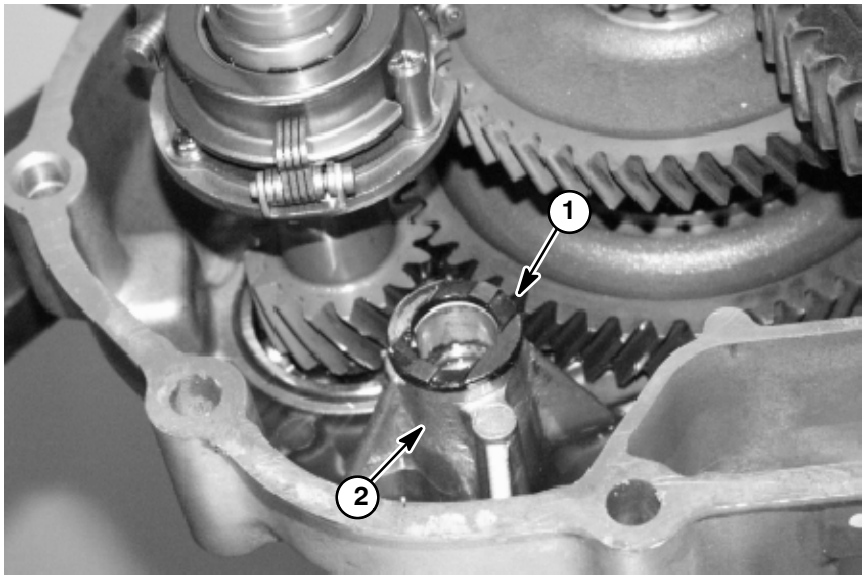


Figure 72

1. **Spacer**
2. **Boss (counter shaft)**

E. Place spacer on the counter shaft boss of the case (LH) so the oil groove faces up.

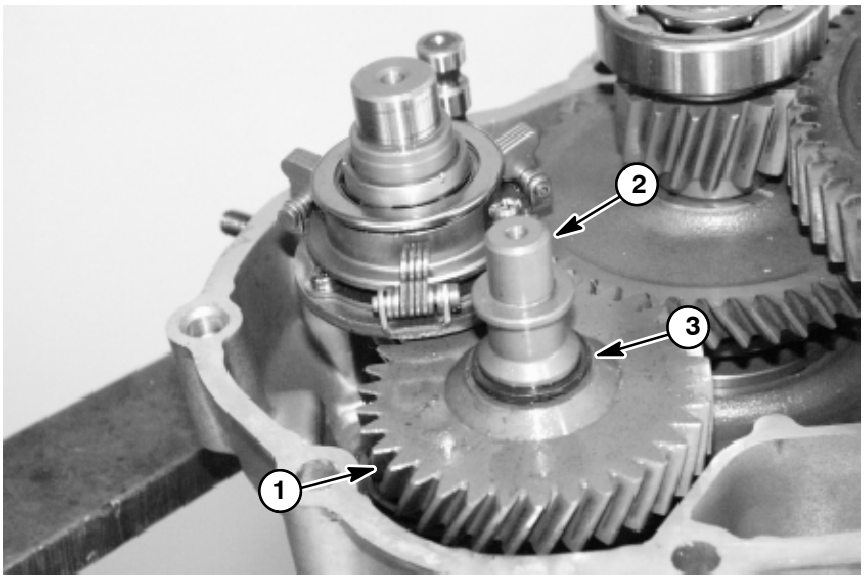


Figure 73

1. **Gear 34**
2. **Counter shaft**
3. **Spacer**

F. Apply molybdenum disulfide grease to the inside of gear 34 and the contact surface between the case and the counter shaft.

G. Place gear 34 onto the spacer. Make sure not to drop the spacer. Insert needle bearing into gear. Insert counter shaft with remaining spacer through the needle bearing, gear 34 and into the spacer and case.

7. Assemble case (LH and RH).

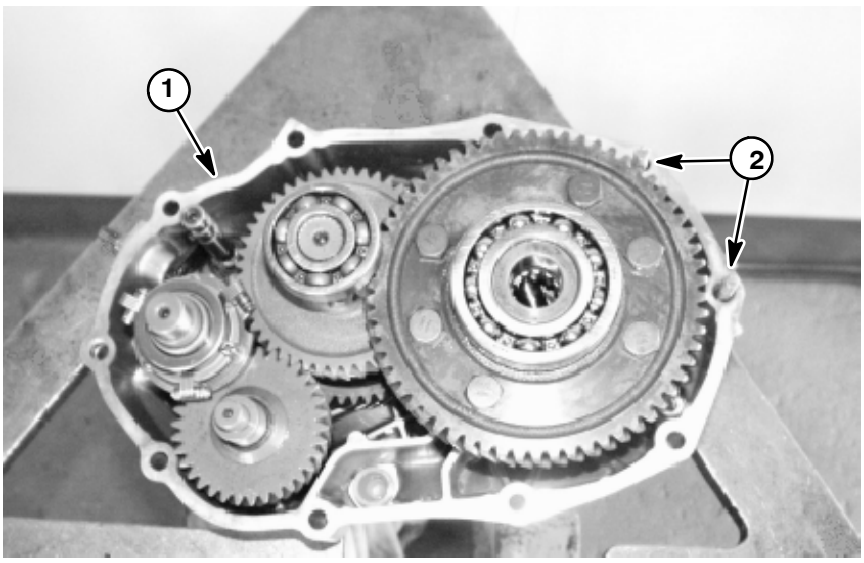


Figure 74

1. **Case (sealing surface)**
2. **Pipe knock**

A. Make sure gasket sealing surfaces of both cases are clean. Install gasket to case.

B. Install both pipe knocks to the case (LH).

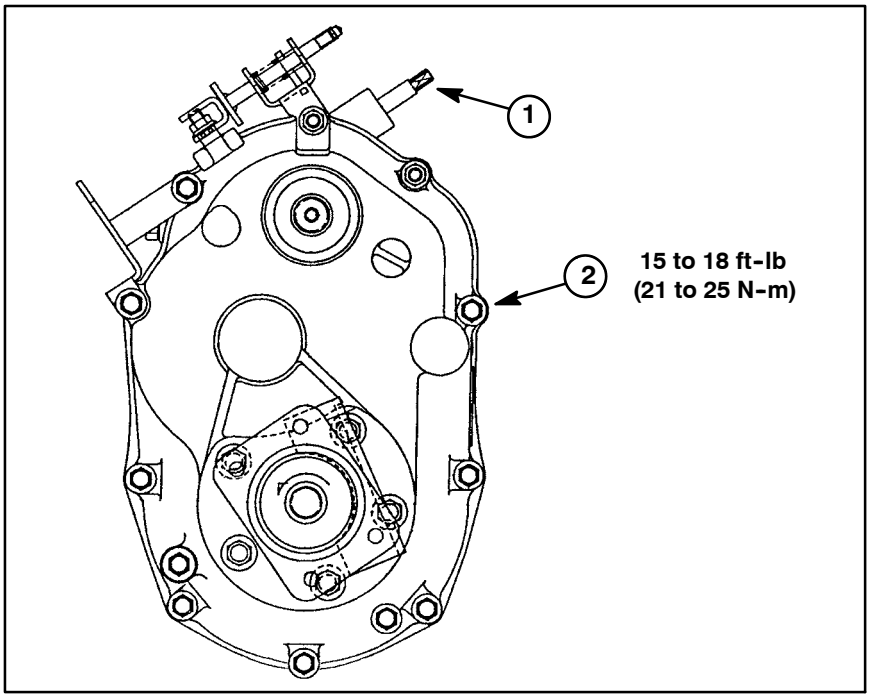


Figure 75

1. Governor shaft (Workman MD)
2. Bolt

**NOTE:** When installing case (RH) to the case (LH) on Workman MD, hold governor shaft so the ball bearing will not drop off. Keep the gasket sealing surfaces of the cases as horizontal to each other as possible. If the sealing surfaces do not join to each other, tap the case lightly with a plastic hammer.

C. Install case (RH) so each shaft fits properly into the case.

D. Secure case (RH) to case (LH) with bolts. Torque bolts from **15 to 18 ft-lb (21 to 25 N-m)**.



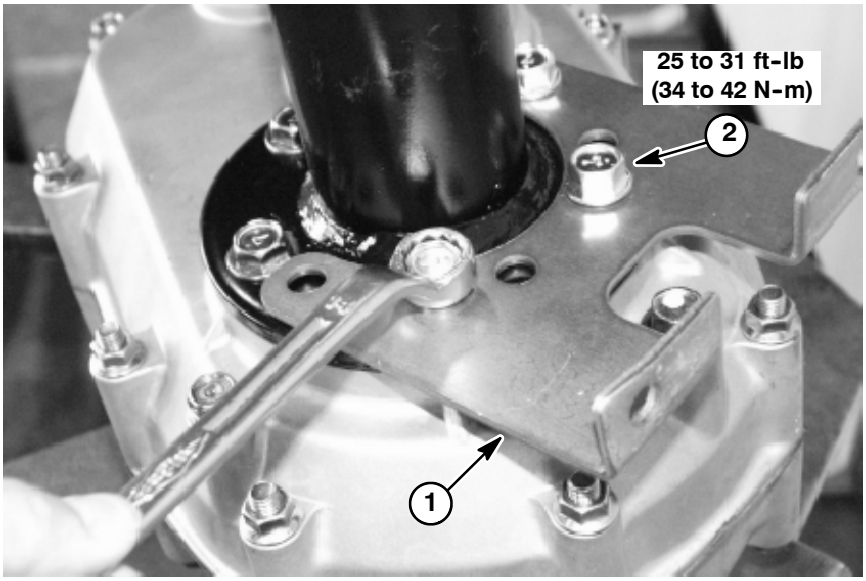


Figure 76

1. Axle bracket
2. Flange bolt

E. Position axle bracket to each axle case. Secure axle bracket to each axle case with flange bolts. Torque bolts from **25 to 31 ft-lb (34 to 42 N-m)**.

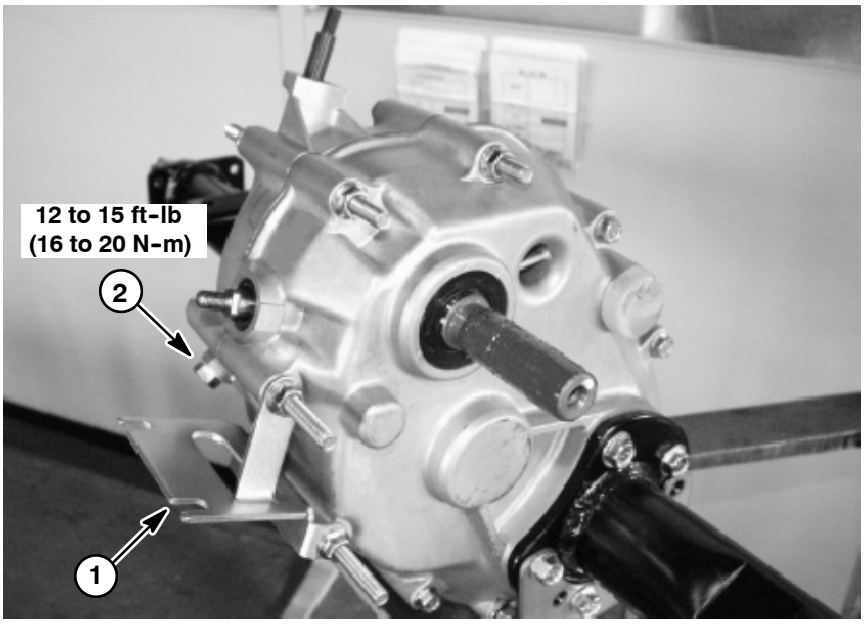


Figure 77

1. **Cable bracket**
2. **Bolt (steel ball, spring & gasket)**

F. Install cable bracket to the transaxle.

G. Install steel ball, spring, gasket and bolt. Torque bolt from **12 to 15 ft-lb (16 to 20 N-m)**.

H. Fill transaxle with 1.5 quarts (1.4 liters) of new 10W-30 motor oil.

# Chapter 6

# Electrical System

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ADVANCED MOTORS & DRIVES STARTER/GENERATOR TROUBLESHOOTING GUIDE

# General Information

### Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

# Electrical Schematics

The electrical schematics and other electrical drawings for the Workman MD and MDX are located in Chapter 8 – Electrical Diagrams.

# Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

## Multimeter

The meter can test electrical components and circuits for current, resistance or voltage.

**NOTE:** Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

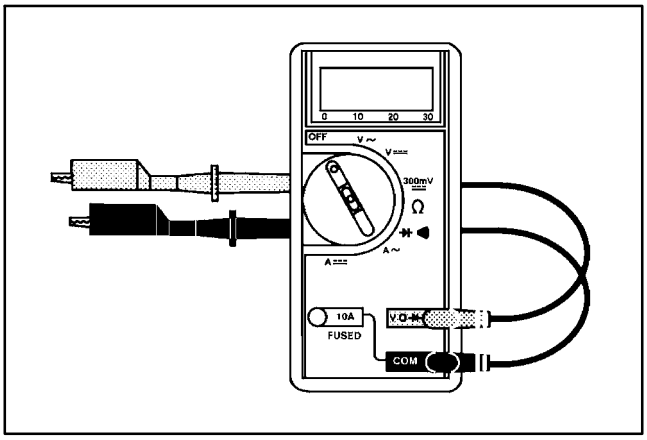


Figure 1

## Skin-Over Grease

Special non-conductive grease which forms a light protective skin which helps waterproof electrical switches and contacts.

Toro Part Number: **505-165**

Figure 2

## Battery Terminal Protector

Aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after the battery cable has been secured to the battery terminal.

Toro Part Number: **107-0392**

Figure 3

## Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.

Figure 4

# Troubleshooting

**CAUTION**

**Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.**

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this vehicle (see Wiring Schematics in Chapter 8 – Electrical Diagrams).

If the vehicle has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

## Starting Problems

| Problem | Possible Causes |
|---|---|
| Starter solenoid clicks, but starter will not crank. | Battery is discharged.<br>Battery cables are loose or corroded.<br>Battery ground to frame is loose or corroded.<br>Wiring at starter is faulty.<br>Starter solenoid is faulty.<br>Starter is faulty and causing an incomplete circuit for the solenoid. |
| Nothing happens when start attempt is made. | Battery is discharged.<br>Wiring to the start circuit components is loose, corroded or damaged (see Wiring Schematics in Chapter 8 – Electrical Diagrams).<br>Battery cables are loose or corroded.<br>Battery ground to frame is loose or corroded.<br>Fuse block is faulty.<br>10 ampere fuse to the ignition switch is loose or blown.<br>The ignition switch is faulty.<br>Switch at accelerator pedal is faulty or needs adjustment.<br>Starter solenoid is faulty.<br>Shutdown module is faulty (Workman MDX). |
| Engine cranks, but does not start. | Wiring to start circuits is loose, corroded or damaged (see Wiring Schematics in Chapter 8 – Electrical Diagrams).<br>Shutdown module is faulty (Workman MDX).<br>Engine or fuel system is malfunctioning (see Engine Chapter).<br>Engine and fuel may be too cold. |

## General Run Problems

| Problem | Possible Causes |
|---|---|
| Battery does not charge. | Wiring to the charging circuit components is loose, corroded or damaged (see Wiring Schematics in Chapter 8 – Electrical Diagrams).<br><br>Voltage regulator and/or starter/generator is faulty.<br><br>Battery is faulty. |
| Engine stops during operation. | Wiring to the run circuit components became broken or disconnected (see Wiring Schematics in Chapter 8 – Electrical Diagrams).<br><br>RPM shutdown module is faulty (Workman MDX).<br><br>Engine or fuel system is malfunctioning (see Engine Chapter). |

# Electrical System Quick Checks

## Battery Test

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60° to 100° F. The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead the the negative battery post.

**NOTE:** This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

| Voltage Measured | Battery Charge Level |
|---|---|
| 12.68 V (or higher) | Fully charged (100%) |
| 12.45 V | 75% charged |
| 12.24 V | 50% charged |
| 12.06 V | 25% charged |
| 11.89 V | 0% charged |

## Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Raise and support cargo box to gain access to battery. Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

**NOTE:** When starting the engine, the battery voltage will drop and then should increase once the engine is running.

**NOTE:** Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Make sure the shift lever is in the neutral position and the parking brake is applied. Start the engine and run engine at high idle **(above 3000 RPM)**. Maintain engine speed to allow the battery to charge for at least 3 minutes. Record the battery voltage.

After running the engine for at least 3 minutes, battery voltage should be at least 0.50 volt higher than initial battery voltage.

An example of a charging system that is functioning:

| **At least 0.50 volt over initial battery voltage.** | |
|---|---|
| Initial Battery Voltage | = 12.30 v |
| Battery Voltage after 3 Minute Charge | = 12.85 v |
| Difference | = +0.55 v |

# Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check on the switch).

**NOTE:** See the Briggs and Stratton Repair Manual for 4 Cycle, V–Twin Cylinder, OHV Head Engines (Workman MDX) or the Kohler Service Manual for Command Pro CS Series Engines (Workman MD) for additional component testing information.

**CAUTION**

**When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.**

## Ignition Switch

The ignition switch used on the Workman has six (6) switch terminals and three (3) key switch positions. Only two of the positions are used (OFF and RUN). The switch terminals are identified as shown in Figure 5.

### Testing

The circuitry of the ignition switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various switch terminals for each key position. Verify continuity between switch terminals.

| POSITION | CIRCUIT |
|---|---|
| OFF | D + E + F |
| ON | A + C + F |

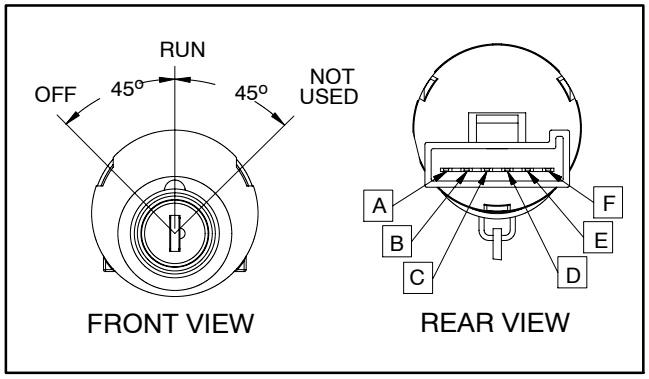


Figure 5

## Hour Meter

### Testing

**IMPORTANT: Make sure to observe polarity on the hour meter terminals when testing. Damage to the meter may result from an improper connection.**

1. Unplug wire harness connector from hour meter.

2. Connect positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.

3. Connect negative (–) terminal of the voltage source to the other terminal of the hour meter.

4. The hour meter should move 1/10 of an hour in six (6) minutes.

5. Disconnect voltage source from the hour meter. Reconnect wire harness connector to hour meter.

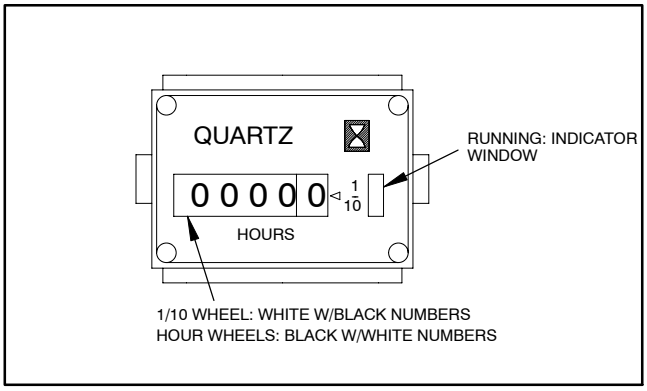


Figure 6

## Headlight Switch

The headlight switch is located on the control panel (Fig. 7). This rocker switch allows the headlights to be turned on and off.

### Testing

The switch terminals are marked as shown in Figure 7. The circuitry of the headlight switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

| SWITCH POSITION | NORMAL CIRCUITS | OTHER CIRCUITS |
|---|---|---|
| ON | 2 + 3 | 5 + 6 |
| OFF | 1 + 2 | 4 + 5 |

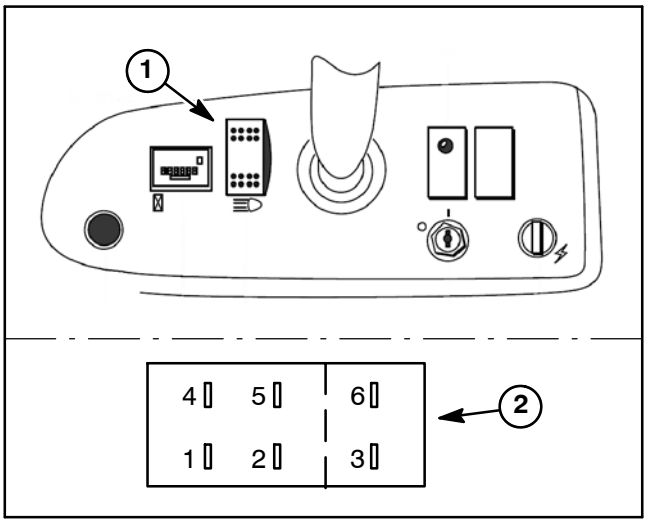


Figure 7

**1. Headlight switch** **2. Back of switch**

## Start/Run Solenoid

The start/run solenoid provides a current path between starter/generator and the vehicle electrical circuits. This solenoid is energized when the ignition switch is ON and the accelerator pedal is depressed. The solenoid is attached beneath the cargo box to a bracket on the right hand side of the rear frame (Fig. 8).

### Testing

**NOTE:** Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Place machine shift lever in the NEUTRAL position. Apply parking brake. Make sure engine is off.

2. Raise cargo box and secure with prop rod. Gain access to start/run solenoid by removing the electrical cover.

3. Disconnect negative (black) cable from battery and then disconnect positive (red) cable (see Battery Service in the Service and Repairs section of this chapter).

4. Note wire connector locations on start/run solenoid for assembly purposes. Disconnect wire harness connectors from solenoid.

5. Apply 12 VDC directly across the solenoid coil posts (steel). The solenoid should click as the solenoid coil is energized. Make sure resistance across the main contact posts (copper) is less than **1 ohm**.

6. Remove voltage from solenoid coil posts. The solenoid should click as the solenoid coil is de-energized. Make sure resistance across the main contact posts is **infinite ohms**.

7. Resistance across the solenoid coil posts (steel) should be approximately **13.5 ohms**.

8. Replace start/run solenoid if necessary.

9. Connect electrical connections to solenoid: positive battery cable and wire to fuse block on one main contact post and starter/generator cable and wire to regulator on the other main contact post. Connect battery cables. Make sure to connect positive (red) cable first and then connect negative (black) cable.

**NOTE:** Voltage is supplied to the solenoid on the Workman whenever the key is in the ON position and the accelerator pedal is depressed.

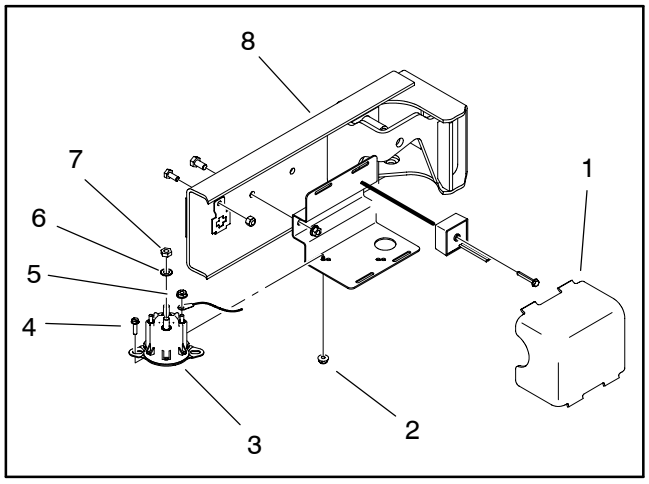


Figure 8

1. **Electrical cover**
2. **Flange nut (2 used)**
3. **Start/run solenoid**
4. **Screw (2 used)**
5. **Nut (2 used)**
6. **Lock washer (2 used)**
7. **Nut (2 used)**
8. **Rear frame**

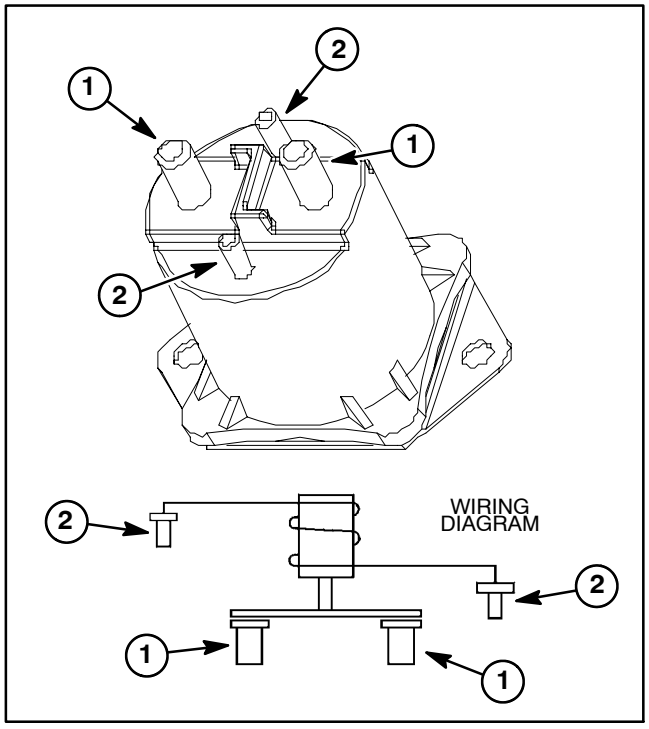


Figure 9

1. **Main posts (copper)**
2. **Solenoid posts (steel)**

## Fuse Block

The fuse block is located beneath the dash panel. Fuses can be removed to check continuity. The test meter should read **less than 1 ohm**.

Fuses protect circuits as follows (Fig. 10):

1. The extreme left fuse protects the optional accessory circuit (if equipped).

2. The middle left 10 ampere fuse protects the ignition system and horn circuits.

3. The middle right 10 ampere fuse protects the light circuit.

4. The extreme right 10 ampere fuse protects the power point circuit. A maximum of a 15 ampere fuse is allowed.

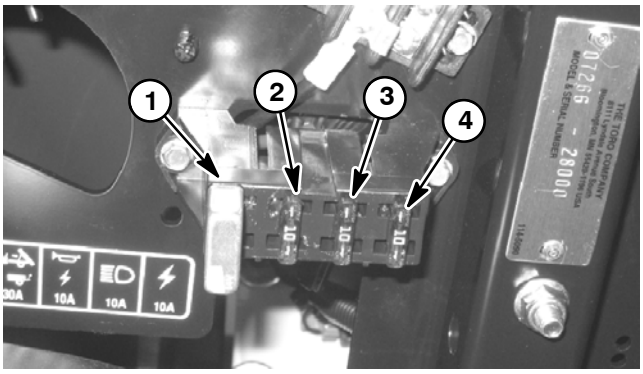


Figure 10

1. **Option**
2. **Ignition system fuse**
3. **Lights fuse**
4. **Power point fuse**

## Accelerator Switch

The accelerator switch is a four (4) terminal, two (2) circuit switch. The switch is attached to the pedal support (Fig. 11).

When the accelerator pedal is pushed, the switch allows current flow to the start/run solenoid, hour meter and engine oil indicator and also provides an open circuit to the engine ignition system to allow the magneto ignition to operate. With the accelerator pedal released, the switch provides a grounding circuit for the engine ignition system and also prevents current flow to the start/run solenoid, hour meter and engine oil indicator.

### Testing

1. Place machine shift lever in the NEUTRAL position. Turn ignition switch off, remove key from ignition switch and engage parking brake.

2. Raise hood to gain access to accelerator switch.

3. Unplug wiring harness connector from switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the switch terminals for both switch positions. Verify continuity between switch terminals using the following table:

| PLUNGER POSITION | CONTINUITY | NO CONTINUITY |
|---|---|---|
| IN | 1 and 2 | 3 and 4 |
| OUT | 3 and 4 | 1 and 2 |

### Adjustment

1. Adjust cap screw on accelerator pedal so switch plunger is not bottomed out when accelerator pedal is released (Fig. 13). Tighten nut to secure cap screw in position.

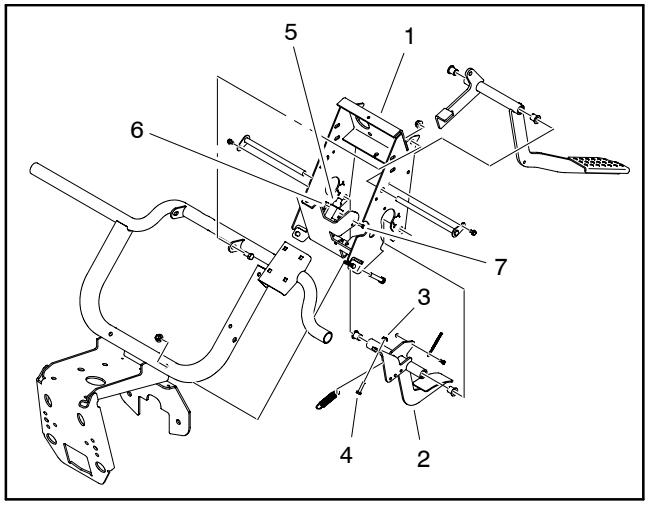


Figure 11

1. **Pedal support**
2. **Accelerator pedal**
3. **Nut**
4. **Cap screw**
5. **Accelerator switch**
6. **Plate**
7. **Cap screw (2 used)**

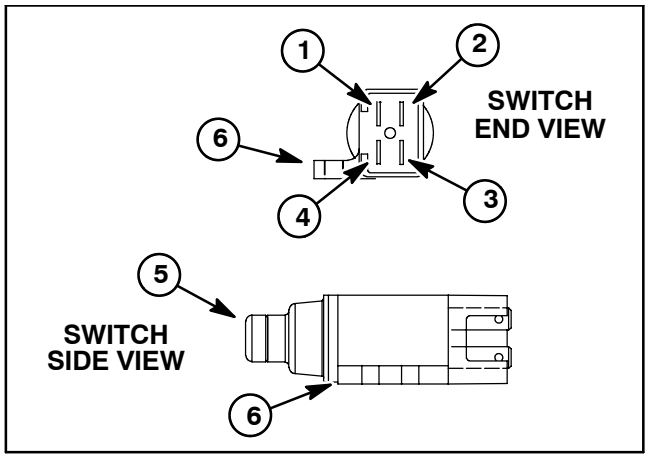


Figure 12

1. **Terminal 1**
2. **Terminal 2**
3. **Terminal 3**
4. **Terminal 4**
5. **Switch plunger**
6. **Mounting tab**

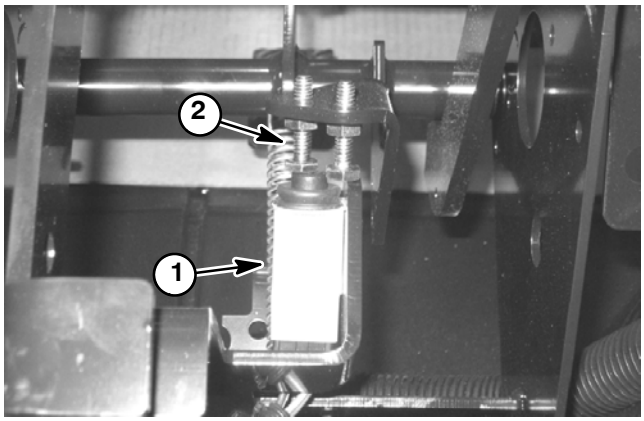


Figure 13

1. **Accelerator switch**
2. **Adjustment screw**

## Starter/Generator & Voltage Regulator

1. Place machine shift lever in the NEUTRAL position. Apply parking brake.

2. Raise cargo box and secure with prop rod. Gain access to electric components by removing the electrical cover.

3. Make sure all wires in the charging circuit are connected correctly and tightly. Note the correct location of starter/generator cable and voltage regulator wire at the start/run solenoid (Fig. 14).

4. Make sure the battery is fully charged. Operate the vehicle for several minutes so the voltage regulator is warmed up. Stop engine and turn key to OFF.

5. Test charging circuit:

   A. Set multimeter to VDC. Connect red (+) probe of the multimeter to the positive (+) battery post. Connect black (–) probe of the multimeter to the negative (–) battery post.

   B. Start and run the engine at mid–range RPM.

   C. Battery voltage should rise to approximately 14.5 VDC identifying a correctly operating charging circuit. If the battery has a low charge, this may take a few minutes.

   D. Stop engine and turn key to OFF.

6. If battery voltage did not rise to 14.5 VDC, test starter/generator:

   A. Disconnect green wire connector from voltage regulator (Fig. 14). Connect disconnected green wire lead from starter/generator to ground with a jumper lead.

   B. Set multimeter to VDC. Connect red (+) probe of the multimeter to the positive (+) battery post. Connect black (–) probe of the multimeter to the negative (–) battery post.

   **IMPORTANT: Run engine only long enough to get battery voltage reading and not for more than 15 seconds.**

   C. Start and run engine at mid–range RPM.

   D. Battery voltage should rise steadily to approximately 18 VDC identifying a correctly operating starter/generator. An incorrect reading indicates the need for starter/generator repair.

   E. Stop engine and turn key to OFF.

7. Reconnect green wire connector from the regulator and test voltage regulator:

   A. Set multimeter to VDC. Connect red (+) probe of the multimeter into the green wire connection. Connect black (–) probe of the multimeter to a known good ground.

   B. Start and run the engine at mid–range RPM.

   C. The measured voltage should be approximately 2 VDC when battery is charging and from 6 to 8 VDC when battery is fully charged. This voltage may rise to 14 VDC when the accelerator pedal is released and the engine is coasting to a stop.

   D. If measured voltage is incorrect, stop engine and replace voltage regulator. Retest charging circuit (Step 5 above).

8. Stop engine and remove multimeter leads.

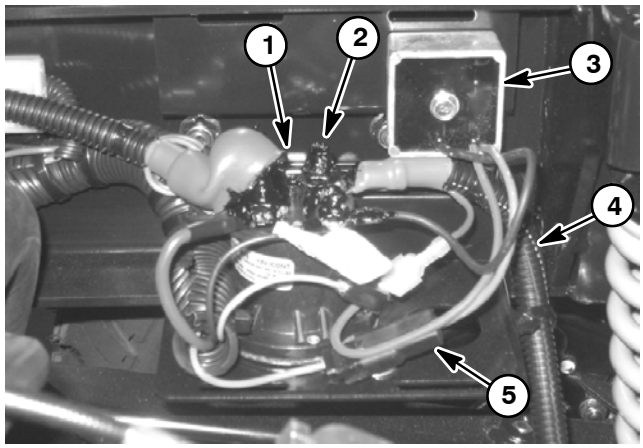


Figure 14

1. Start/run solenoid
2. Main contact post
3. Voltage regulator
4. Cable to starter/gen.
5. Green wire connector

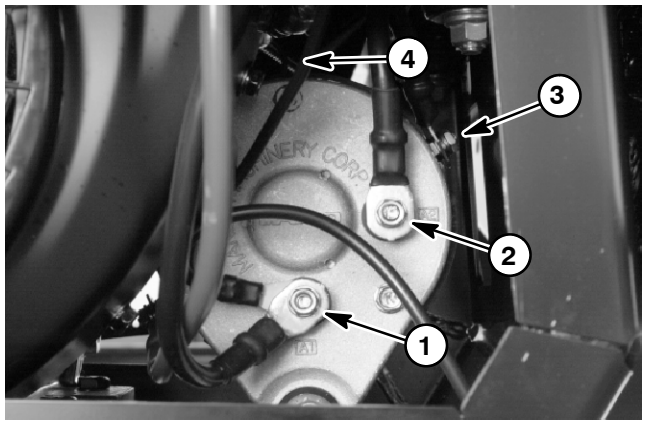


Figure 15

1. Terminal A1
2. Terminal A2
3. Terminal F1 location
4. Terminal DF location

## Starter/Generator

Testing of starter/generator field and armature windings is difficult with the starter/generator still mounted in the Workman. Follow the procedures for Starter Generator & Voltage Regulator Component Testing prior to removing the starter generator for further testing and repairs.

Starter generator resistance tests are as follows:

**NOTE:** Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Disconnect wire connections on starter/generator to separate circuits.

2. If starter/generator is a Valeo brand (identified by Valeo on commutator end cover of starter/generator and through bolts that are in−set from outer diameter of end cover) (Fig. 16):

   A. Measure resistance (Ohms) between starter generator terminals DF and F1 (field). The meter reading should be 5.5 to 5.9 Ohms.

   B. Measure resistance (Ohms) between starter generator terminals A1 and A2 (armature). The meter reading should be under 1 Ohm (but not zero).

   C. Measure resistance between each terminal and ground. The meter reading should be infinite (no continuity).

3. If starter/generator is a Advanced Motor and Drives brand (identified by through bolts that are near the outer diameter of commutator end cover) (Fig. 17):

   A. Measure resistance (Ohms) between starter generator terminals F1 and F2. The meter reading should be very low (approximately 0.006 Ohms).

   B. Measure resistance (Ohms) between starter generator terminals DF and F1. The meter reading should be approximately 3 to 6 Ohms.

   C. Measure resistance between each terminal and ground. The meter reading should be infinite (no continuity).

4. Starter/generator disassembly and repair will be needed if readings are incorrect (see Starter/Generator Service in the Service and Repairs section of this chapter).

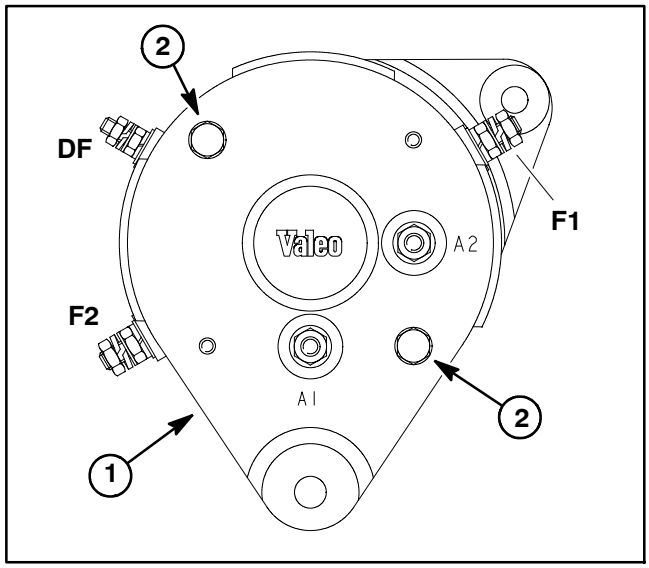


Figure 16

1. **Valeo Starter/Generator end cover view**
2. **Through bolt (2 used)**

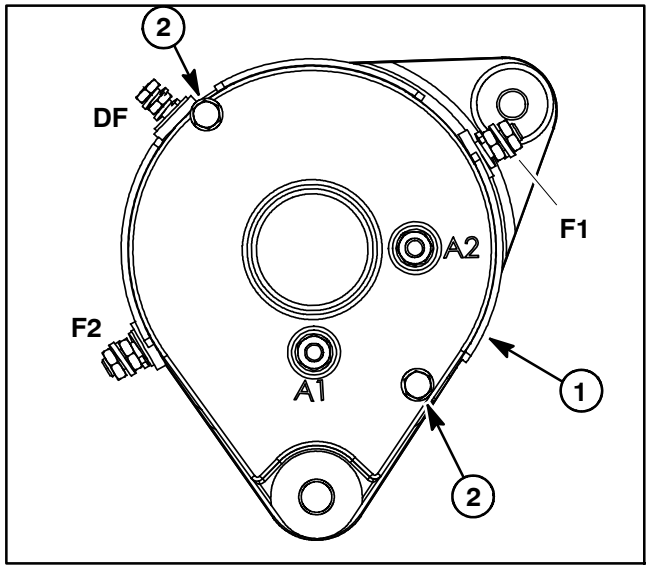


Figure 17

1. **Advanced Motors Starter/Generator end cover view**
2. **Through bolt (2 used)**

## Diode Assembly

The diode D1 (Fig. 17) is used to protect the ignition switch from voltage spikes that can occur when the starter solenoid is de−energized. The diode plugs into the wiring harness.

### Testing

The diode can be tested using a digital multimeter (diode test or ohms setting) and the table to the right.

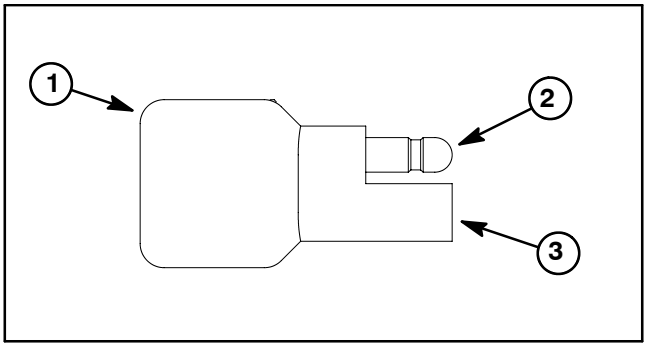


Figure 17

1. Diode
2. Male terminal
3. Female terminal

| Multimeter Red Lead (+) on Terminal | Multimeter Black Lead (-) on Terminal | Continuity |
|---|---|---|
| Female | Male | YES |
| Male | Female | NO |

## RPM Shutdown Module (Workman MDX)

The RPM shutdown module allows the engine to continue running briefly after the accelerator pedal is released and the vehicle is decelerating. The module monitors engine speed at the engine stop switch terminal. Through the RPM shutdown module, the engine ignition system is not grounded until the engine speed has slowed to approximately 1300 RPM. By allowing the engine to continue running briefly during vehicle deceleration, better vehicle performance can be achieved.

### Testing

1. Make sure that accelerator switch is working correctly and is adjusted properly (see Accelerator Switch in this section).

2. Place drive system in the NEUTRAL position.

3. Connect an ignition spark tester in series between a spark plug and spark plug wire.

4. Start engine and monitor engine speed with a tachometer. Press the accelerator pedal to raise engine speed briefly and then release pedal while watching the tachometer and spark tester. When engine speed decreases to approximately 1300 RPM, the spark tester should register no spark and the engine should stop.

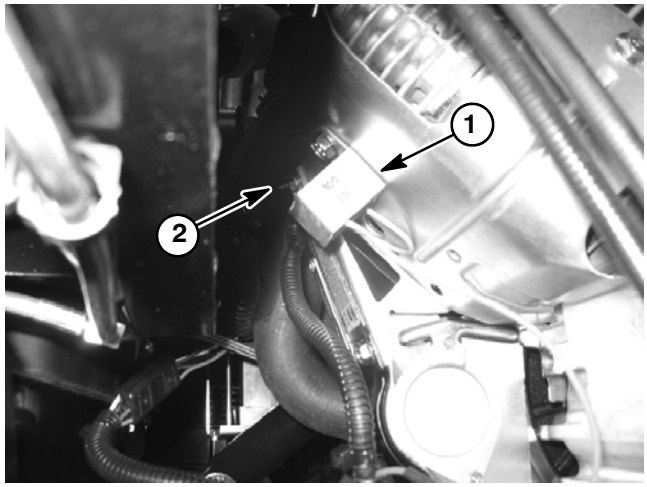


Figure 18

1. RPM shutdown module
2. Stop switch terminal

## Oil Pressure Switch (Workman MDX)

The oil pressure switch is located on the mounting adapter for the oil filter. It is a normally closed switch that opens with pressure.

**Oil pressure switch testing**

1. Turn the ignition switch to ON. The oil indicator light on the dash should be illuminated.

2. If the light is not on, disconnect the wire from the oil pressure switch and ground the wire to the engine block.

3. If the light comes on, the oil pressure switch is faulty.

4. If the light does not come on after step 2, check the indicating circuit (see Electrical Schematic in Chapter 8 – Electrical Diagrams).

**If the oil indicator light comes on with the engine running:**

1. Shut off the engine **immediately**.

2. Disconnect the wire from the oil pressure switch.

3. Turn the ignition switch to ON. The oil indicator light should go out.

4. If the light is still on, check for short circuiting in the indicating circuit (see Electrical Schematic in Chapter 8 – Electrical Diagrams).

5. Refer to the Briggs and Stratton Repair Manual for 4 Cycle, V–Twin Cylinder, OHV Head Engines for additional testing information.

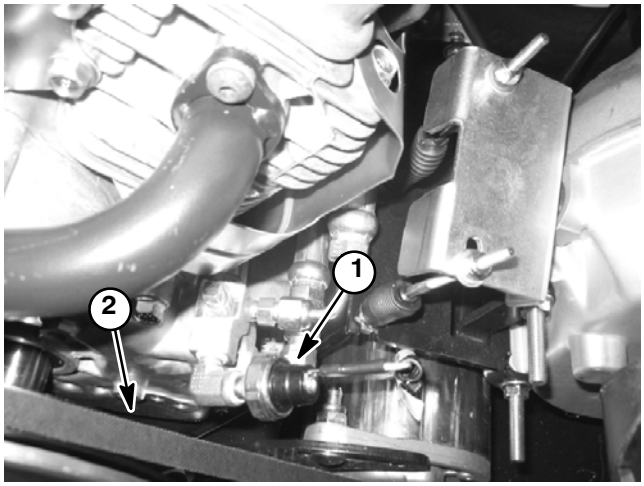


Figure 19

1. Oil pressure switch
2. Generator belt

## Audio Alarm (Reverse) (Optional)

If vehicle is equipped with the optional audio alarm, whenever the shift lever is placed in the reverse position the audio alarm should sound. The alarm is attached beneath the cargo box to a bracket on the right side of the frame.

**Testing**

1. Place machine shift lever in the NEUTRAL position. Make sure that ignition switch is off, remove key from ignition switch and engage parking brake.

2. Raise cargo box and secure with prop rod. Gain access to audio alarm by removing the electrical cover.

**IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.**

3. Disconnect wire harness connector from alarm. Correctly connect 12VDC source to the terminals (Fig. 20). Alarm should sound.

4. Remove voltage source from the alarm. Replace alarm if necessary. Connect wire harness connector to alarm.

5. Install electrical cover and lower cargo box.

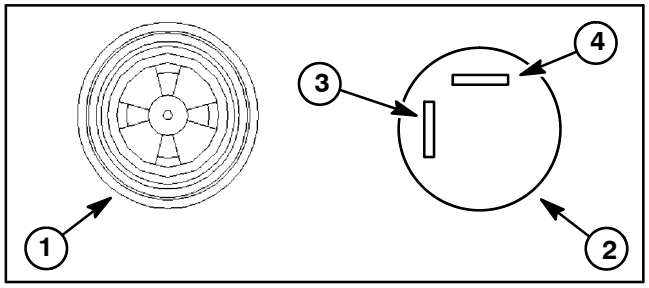


Figure 20

1. Top view
2. Bottom view
3. Positive (+) terminal
4. Negative (–) terminal

## Reverse Switch (Optional)

The optional reverse switch is a four (4) terminal, two (2) circuit switch that is used to energize the audio alarm when the shift lever is in the reverse position. The normally open switch circuit is used while the normally closed switch circuit is not used. If equipped, this switch is attached to the shift bracket in the seat base (Fig. 21).

### Testing

1. Place machine shift lever in the NEUTRAL position. Make sure that ignition switch is off, remove key from ignition switch and engage parking brake.

2. Remove four (4) screws and carefully slide shift bracket assembly from front of seat base to gain access to reverse switch.

3. Unplug wiring harness connector from reverse switch.

4. With the use of a multimeter (ohms setting), check that the normally open switch contacts (Fig. 22) do not have continuity when the switch plunger is extended. The contacts should have continuity when the switch plunger is fully depressed.

5. When testing is complete, connect wire harness connector to switch. Slide shift bracket into seat base and secure with four (4) screws.

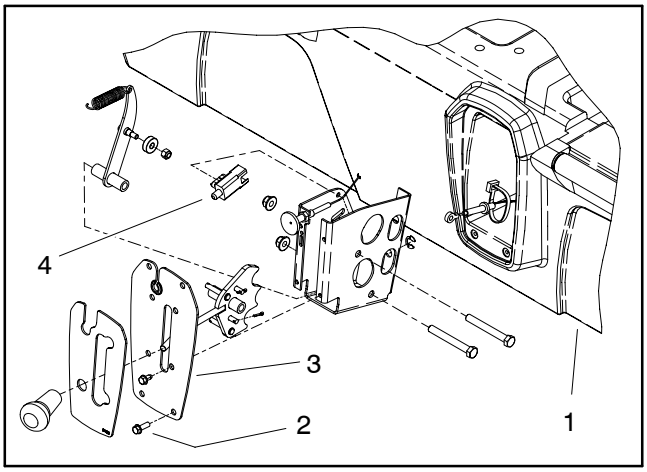


Figure 21

1. **Seat base**
2. **Screw (4 used)**
3. **Shifter plate**
4. **Reverse switch**

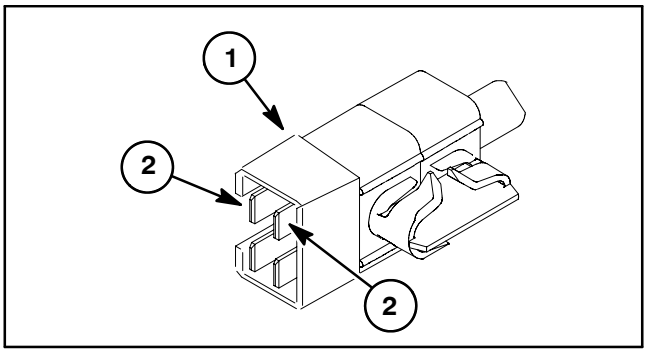


Figure 22

1. **Reverse switch**
2. **Normally open contact**

# Service and Repairs

**NOTE:** For information on electrical engine components, see the Briggs and Stratton Vanguard Service and Repair Manual for 4−Cycle, V−Twin Cylinder, OHV Engines (Workman MDX) or the Kohler Service Manual for Command Pro CS Series Engines (Workman MD).

## Starter/Generator

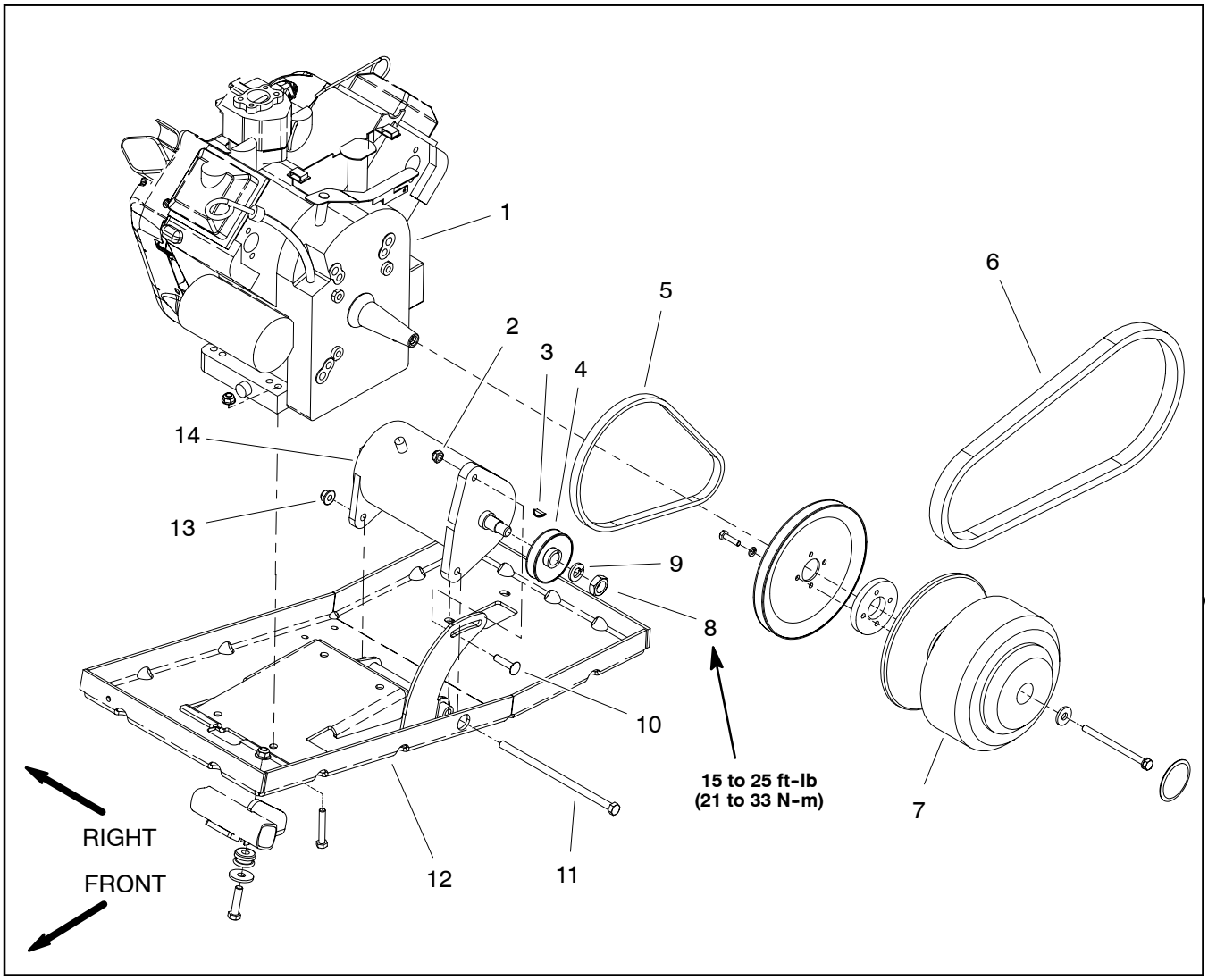


Figure 23

1. **Engine**
2. **Lock nut**
3. **Woodruff key**
4. **Starter/generator pulley**
5. **Starter/generator belt**
6. **Drive belt**
7. **Drive clutch**
8. **Nut**
9. **Lock washer**
10. **Carriage bolt**
11. **Pivot bolt**
12. **Engine tray**
13. **Flange nut**
14. **Starter/generator**

**Removal (Fig. 24)**

1. Park vehicle on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Raise cargo box and secure with prop rod to gain access to the starter/generator.

**NOTE:** Place all fasteners back onto starter/generator terminals after disconnecting wires to prevent loss of fasteners.

3. Label all wires on the starter/generator for assembly purposes. Disconnect all wires from the starter/generator.

4. Loosen fasteners that secure starter/generator to engine tray assembly.

5. Pivot starter/generator and remove drive belt from the pulley.

6. Support starter/generator to prevent it from shifting or falling.

7. Remove lock nut (item 2) and carriage bolt (item 10) from upper starter/generator flange and bracket on engine tray. Remove flange nut (item 13) and pivot bolt (item 11) from starter/generator and engine tray.

8. Remove starter/generator from the vehicle.

9. If necessary, remove pulley from the starter/generator shaft:

   A. Remove nut and spring washer from the shaft. Use appropriate puller to remove pulley from the shaft.

   B. Remove woodruff key from the shaft.

**NOTE:** Vehicles with serial number below 311000000 were produced with a Valeo brand starter/generator. Vehicles with serial number above 311000000 were produced with an Advanced Motors and Drives brand starter/generator. If a Valeo starter/generator has been replaced for some reason, the replacement starter/generator may have been an Advanced Motors and Drives component. Starter/generators have an identification tag on them which identifies the brand. Service information for these two (2) types of starter/generators is included in this chapter. Make sure to use the correct information for the component that is being serviced.

**Installation (Fig. 24)**

1. If removed, install pulley to the starter/generator shaft:

   A. Position woodruff key to the shaft. Slide pulley onto the shaft with the larger diameter pulley hub installed toward starter/generator.

   B. Secure pulley to the shaft with spring washer and nut. Torque nut from **15 to 25 ft-lb (20 to 34 N-m)**.

2. Position starter/generator to the engine tray assembly.

   A. Insert pivot bolt through the starter/generator front bracket, engine mount and starter/generator rear bracket. Install flange nut onto the pivot bolt.

   B. Tighten flange nut enough so starter/generator pivots with slight resistance.

   C. Install carriage bolt through upper starter flange and bracket on engine tray.

   D. Thread lock nut onto carriage bolt.

3. Correctly connect all wires to the starter/generator.

4. Install drive belt to the pulley and adjust belt tension. Make sure that all fasteners are tightened after belt adjustment.

5. Lower and secure cargo box.

## Starter/Generator Service (Valeo Starter/Generator)

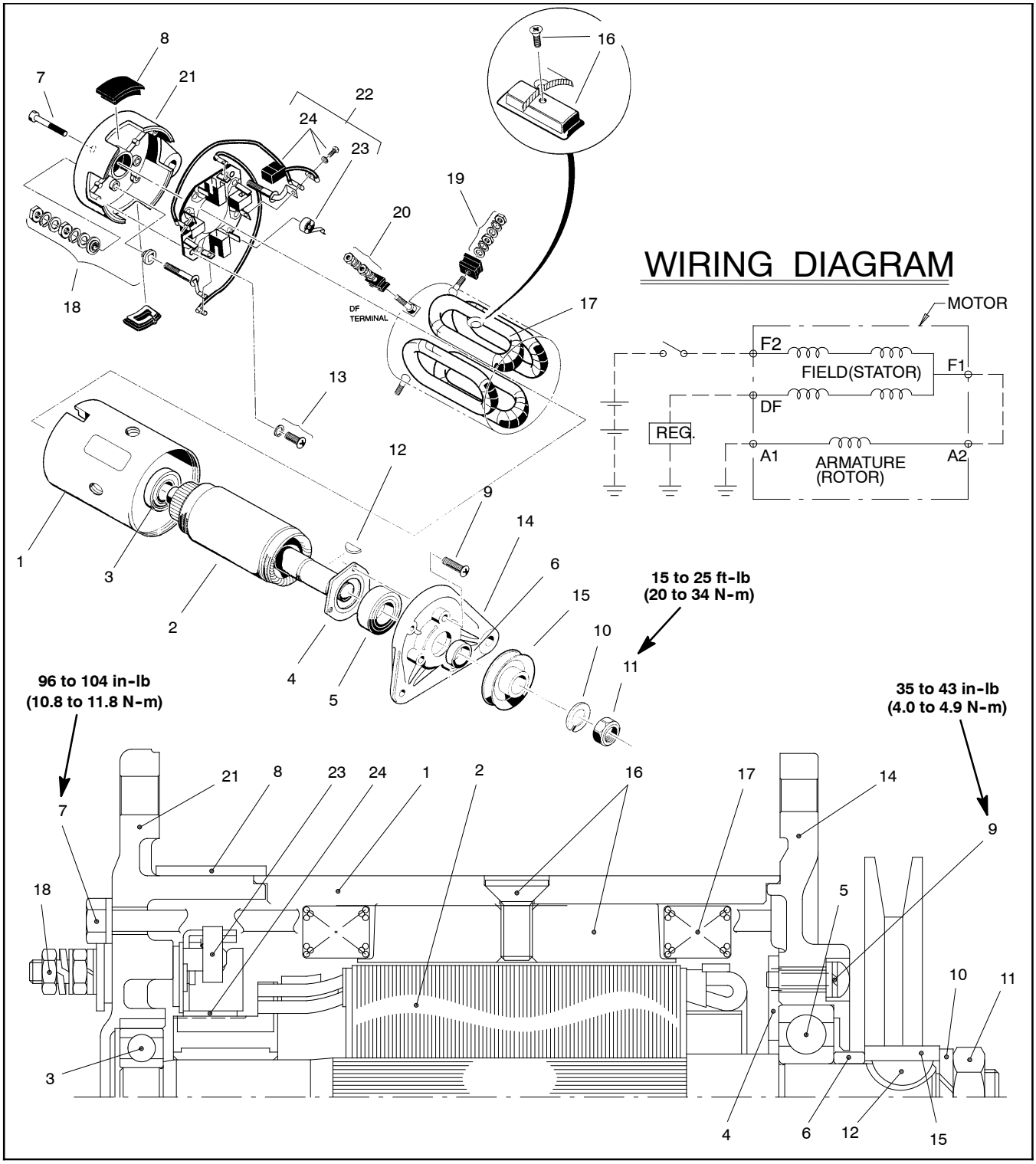


Figure 25

1. Yoke
2. Armature kit
3. Ball bearing
4. Bearing retainer
5. Ball bearing
6. Spacer
7. Through bolt & flat washer
8. Brush cover
9. Screw, lock washer & flat washer
10. Spring washer
11. Hex nut
12. Woodruff key
13. Screw and washer
14. End cover (front)
15. Pulley
16. Pole piece and set screw
17. Field coil (stator) assembly
18. Screw and mold assembly
19. Screw set
20. Screw set
21. End cover (commutator)
22. Brush holder kit
23. Brush spring
24. Brush and screw set

**Brush and Brush Spring Service (Fig. 24)**

**IMPORTANT: When removing or installing the commutator end cover, make sure brushes do not contact the commutator. Damage to the brushes may result.**

1. Remove brush covers from the commutator end cover. Lift brush springs from the notch at the end of the brushes while pulling the brushes out. Allow springs to hold brushes out from the center (Fig. 25).

2. Remove both through bolts and flat washers securing the commutator end cover to the yoke. Separate end cover from the commutator and yoke.

**IMPORTANT: Use clean, dry, lint-free rags when cleaning the starter/generator. When using compressed air, air should be filtered and should not exceed 15 PSI (103 kPa).**

3. Remove brushes from their holders. Clean carbon dust from the commutator end cover and brushes.

**IMPORTANT: Label armature leads connected to brush leads prior to disconnecting any brush leads.**

4. Inspect brushes for damage.

   A. Replace any brush that is cracked or severely chipped.

   B. If the length from the end of the brush to the wear line is less than 0.063 inch (1.6 mm), replace all four (4) brushes (Fig. 26).

5. Inspect brush springs for heat discoloration. Replace all four brushes if any brush is straw or bluish colored.

6. Check brush springs for correct tension.

   A. Secure all four (4) brushes into their holders with the brush springs.

   B. Using a spring scale, check tension on all four (4) brushes in the direction of the spring (Fig. 27).

   C. Replace all four (4) springs if any spring's tension is less than 24 ounces (1.6 N).

7. Secure brush and armature leads with set screws and lock washers.

8. Lift brush springs from the notch at the end of the brushes while pulling the brushes out. Allow springs to hold brushes out from the center (Fig. 25).

9. Position commutator end cover to the commutator and yoke. Secure commutator end cover to the yoke with both through bolts and flat washers. Torque bolts from **96 to 104 in-lbs (10.8 to 11.8 N-m)**.

10. Slide brushes into holders. Secure brushes by positioning brush springs into the notch at the end of the brushes (Fig. 27).

11. Install brush covers to the commutator end cover.

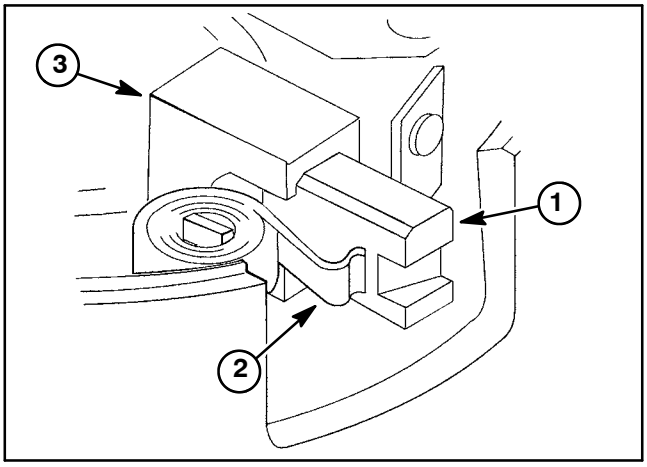


Figure 25

1. **Brush**
2. **Spring**
3. **Brush holder**

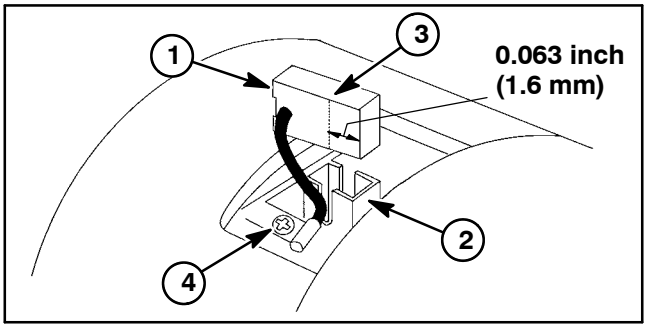


Figure 26

1. **Brush**
2. **Brush holder**
3. **Wear line**
4. **Set screw**

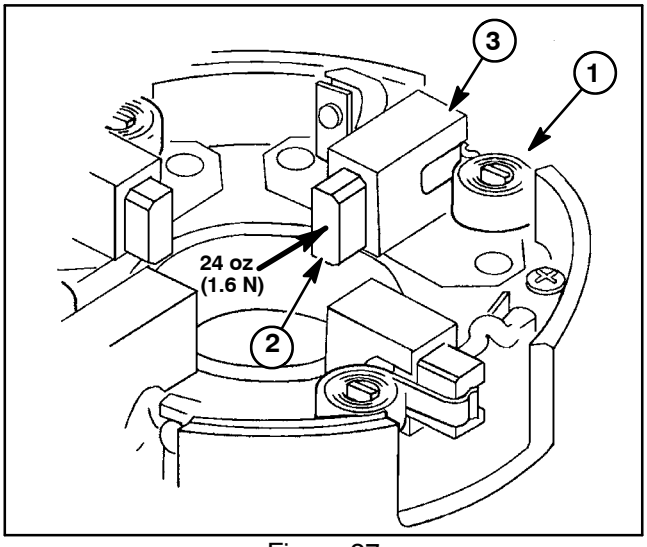


Figure 27

1. **Brush spring**
2. **Brush**
3. **Brush holder**

**Armature and Field Coil Service (Fig. 24)**

**IMPORTANT: When removing the commutator end cover, make sure brushes do not contact the commutator. Damage to the brushes may result.**

1. Remove brush covers from the commutator end cover. Lift brush springs from the notch at the end of the brushes while pulling the brushes out. Allow springs to hold brushes out from the center (Fig. 25).

2. Remove both through bolts and flat washers securing the commutator end cover to the yoke. Separate end cover from the commutator and yoke.

3. Separate front end cover from the armature shaft.

   A. Remove hex nut, spring washer, pulley, spacer and woodruff key from the armature shaft.

   B. Remove screws, lock washers and flat washers securing the retainer to the end cover.

**IMPORTANT: Use clean, dry, lint-free rags when cleaning the starter/generator. When using compressed air, air should be filtered and should not exceed 15 PSI (103 kPa).**

**IMPORTANT: Remove bearings only if they are to be replaced. Use proper bearing removal and installation tools.**

4. Clean bearings using a clean cloth. Inspect bearings for damage. Replace both bearings if either bearing meets any of the following conditions:

   A. Bearings do not spin smoothly, are noisy when spinning or have excessive end or axial play.

   B. The balls or rolling surfaces are pitted or worn.

   C. Bearings are rusted, worn, cracked or show abnormal color due to overheating.

5. Clean and inspect armature. Replace armature if insulation is burned or charred, wires are broken, shaft is damaged or bent, armature core lamination is damaged or solder is thrown.

**IMPORTANT: Never use emery cloth on the commutator; short circuiting of the commutator bars may result. Never use oil or lubricants on the commutator or brushes.**

6. Clean and inspect commutator.

   A. Remove carbon dust, dirt and oil from the commutator.

   B. Lightly remove slight roughness, burning or glazing of the commutator with 400 grit (or finer) sandpaper. Clean commutator after sanding.

   C. Replace armature and bearings if commutator bars are loose. Raised bars may be reworked (see Rework Starter/Generator).

7. Measure diameter of the commutator using a micrometer.

   A. Measure diameter at two points along the axis of the commutator and shaft. Measurements must also be 90° apart along the circumference of the commutator.

   B. If diameter is less than 1.575 inches (40 mm), replace armature and bearings.

8. Clean armature completely with clean cloth and/or air. **Do not use solvent.** Make sure slots between commutator bars are free of dust and metal particles.

9. Inspect field coils (Fig. 29).

   A. Replace field coils if insulation is blackened, charred, flaking or cracked.

   B. Make sure poles are tight.

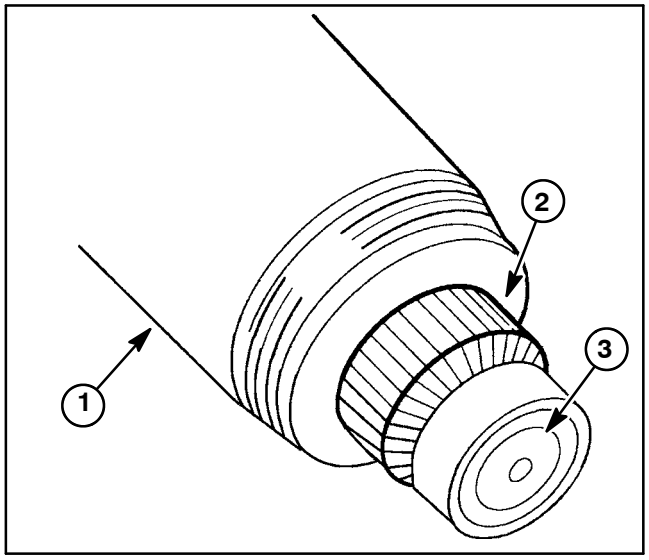


Figure 28

1. **Armature**
2. **Commutator**
3. **Armature shaft**

**IMPORTANT: Do not remove field coils unless they are to be replaced.**

10. To remove field coils (Fig. 29):

    A. Remove nuts from threaded terminal. Slide insulator and terminal out of yoke.

    B. Remove four (4) pole piece screws and pole sets from the yoke. Remove field coils from the yoke.

11. Assemble starter/generator as follows:

    A. Position field coil into yoke. Make sure both insulators that look similar go into the slots marked F1 and F2. The different looking insulator goes into the slot marked DF. Seat insulators into slots (Fig. 29).

    **IMPORTANT: Make sure field coil terminal wire will not make contact with the armature.**

    B. Install terminals through wire connectors and insulators. Secure flat washer, lock washer and nut onto each terminal. Torque nuts from **43 to 52 in-lb (4.9 to 5.9 N-m)** (Fig. 29).

    C. Position all four (4) pole pieces into the yoke. Secure pole pieces with set screws. Torque screws to **9 ft-lb (12 N-m)** (Fig. 29).

    D. Position bearing retainer onto the output shaft of the armature. Press new ball bearing onto the shaft being careful not to damage the retainer.

    E. Press new ball bearing onto the commutator end of the armature shaft.

    F. Position front end cover onto the output shaft. Secure bearing retainer to the end cover with flat washers, lock washers and screws. Torque screws from **35 to 43 in-lb (4.0 to 4.9 N-m)**.

    G. Position armature carefully into the yoke. Make sure not to damage field coils. Align front end cover to the yoke with the locating pin.

    **IMPORTANT: When installing the commutator end cover, make sure brushes do not contact the commutator. Damage to the brushes may result.**

    H. Lift brush springs from the notch at the end of the brushes while pulling the brushes out. Allow springs to hold brushes out from the center (Fig. 25).

    I. Position commutator end cover carefully to the commutator and yoke. Align end cover to the yoke with the locating pin.

    J. Secure both end covers to the yoke with both through bolts and flat washers. Torque bolts from **96 to 104 in-lbs (10.8 to 11.8 N-m)**.

    K. Slide brushes into holders. Secure brushes by positioning brush springs into the notch at the end of the brushes (Fig. 27).

    L. Install brush covers to the commutator end cover.

    M. Position spacer and woodruff key onto the shaft. Place pulley onto the shaft.

    N. Secure pulley to the shaft with spring washer and nut. Torque nut from **15 to 25 ft-lb (20 to 34 N-m)**.

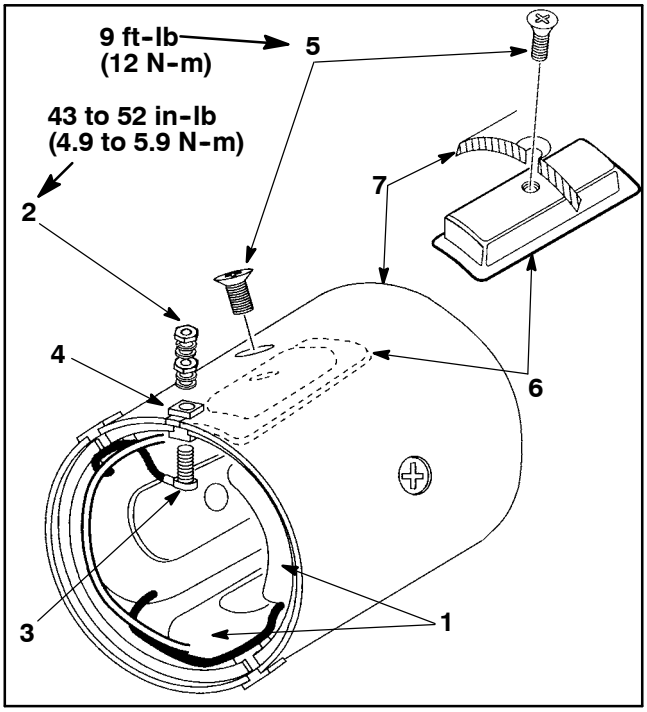


Figure 29

1. Field coils
2. Nut and washers
3. Threaded terminal
4. Insulator
5. Set screw
6. Pole piece
7. Yoke

**Rework Starter/Generator (Fig. 24)**

**NOTE:** Rework to the starter/generator must be performed by a properly trained technician using the correct tools and equipment for testing and reworking electrical motors and generators. It may be more economically feasible to replace the starter/generator than have it reworked.

| Detail | Specification |
|---|---|
| Minimum commutator diameter | 1.575 inches (40 mm) |
| Commutator concentricity to the shaft | 0.0003 inch (0.008 mm) |
| Commutator machining limit per cut | 0.005 inch (0.127 mm) |
| Insulator depth between commutator bars | 0.020 inch (0.5 mm) |
| Armature insulation resistance | 0.2 Mohm at 500 VDC |
| Dielectric (insulation strength) | 500 VDC for one minute with no insulation break down |
| Starter field coil resistance | 2.38 to 2.44 ohms at 20°C (68°F) |
| Generator field coil resistance | 0.041 ohm for F1 and 0.043 ohm for F2 at 20°C (68°F) |

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## Starter/Generator Service (Advanced Motors and Drives Starter/Generator)

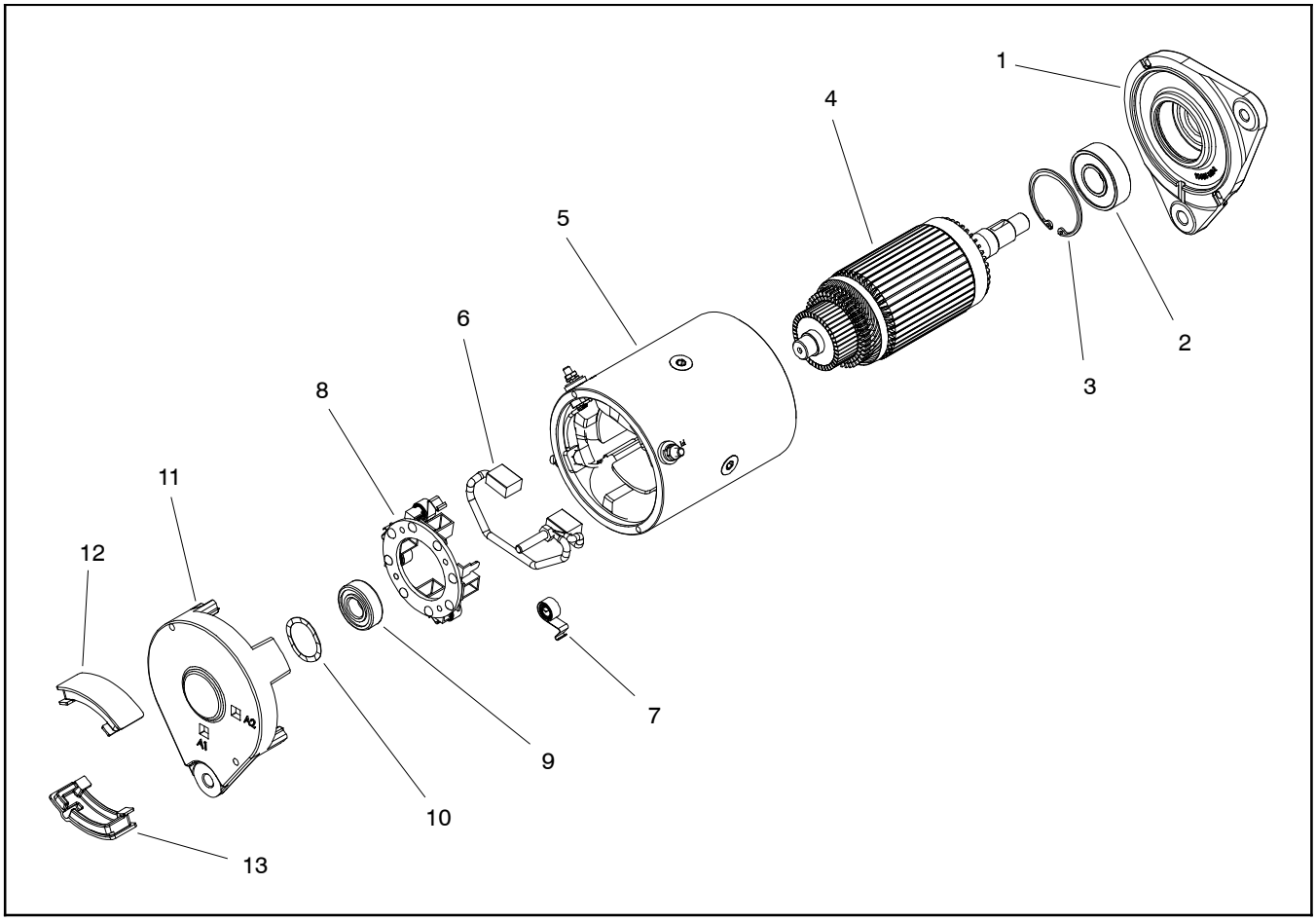


Figure 31

1. **Drive head end**
2. **Bearing**
3. **Retaining ring**
4. **Armature assembly**
5. **Frame and field assembly**
6. **Brush kit**
7. **Brush spring (4 used)**
8. **Brush box assembly**
9. **Bearing**
10. **Wave washer**
11. **Commutator end head**
12. **Rubber plug (3 used)**
13. **Rubber plug (with weep hole)**

**NOTE:** A troubleshooting guide for the Advanced Motors and Drive starter/generator is included at the end of this chapter. Refer to this guide when diagnosing a starter/generator problem on vehicles equipped with an Advanced Motors and Drive starter/generator.

**Brush and Brush Spring Service**

1. Gain access to brushes by carefully removing rubber plugs from commutator end head of starter/generator. For assembly purposes, note location of the plug that includes a weep hole.

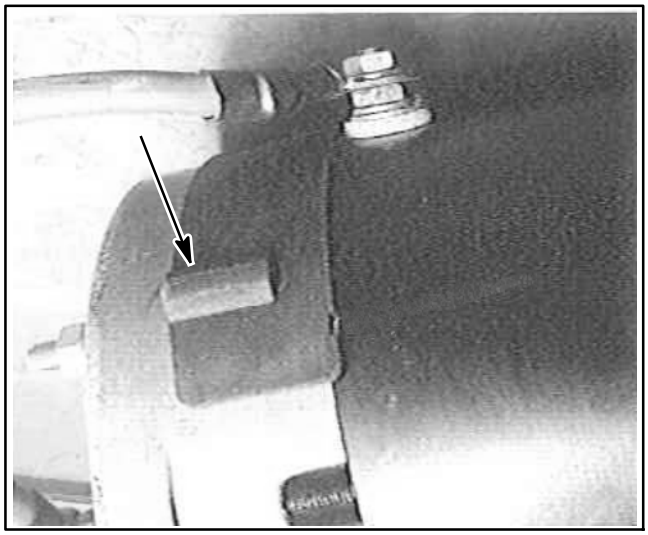

Figure 32

2. Check the length of the brush that extends from the top of the brush box. If the brush is less than **0.140" (3.5 mm)** from the top of the brush box, brush replacement is necessary.

Figure 33

3. Use a marker to make a **diagonal** line across the frame housing and end heads for assembly purposes. Position the starter/generator on the commutator end head and support the assembly to prevent damage to the terminals in the end head. Remove the two (2) screws that secure the drive end head to the frame housing.

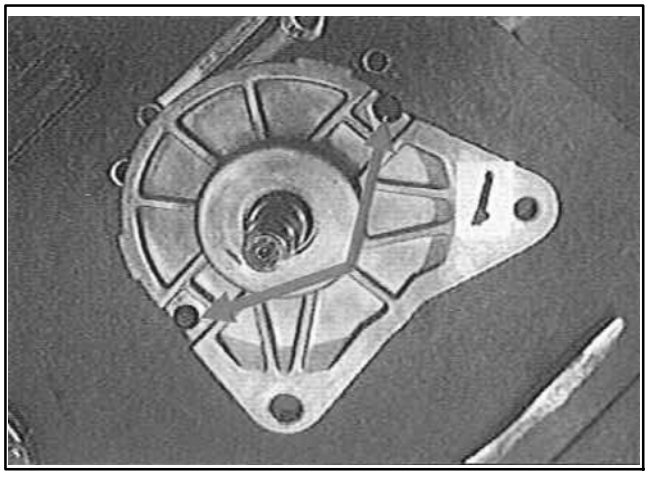

Figure 34

4. Pull drive head end along with attached armature from the frame housing.

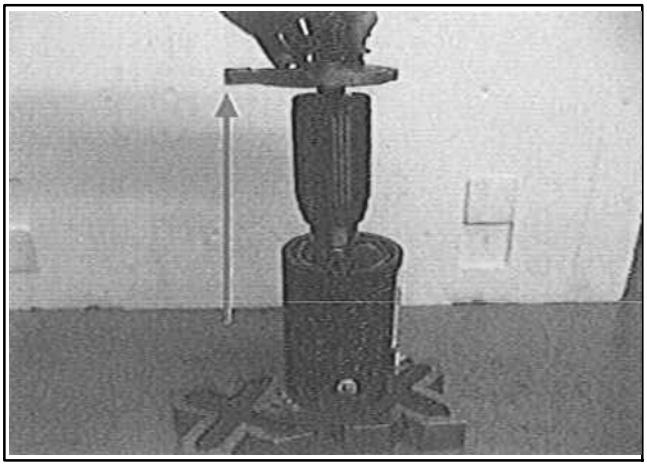

Figure 35

5. Position the motor so the commutator end head is facing upwards and remove the two (2) screws that secure the commutator end head. Lift commutator end head from frame housing.

6. Locate and retrieve wave washer from between armature and commutator end head.

**IMPORTANT: Use clean, dry, lint-free rags when cleaning the starter/generator. When using compressed air, air should be filtered and should not exceed 15 PSI (103 kPa).**

7. Clean inside of the frame housing with compressed air.

**IMPORTANT: Remove bearings from armature only if they are to be replaced. Use proper bearing removal and installation tools.**

8. Clean bearings using a clean cloth. Inspect bearings for damage. Replace both bearings if either bearing meets any of the following conditions:

A. Bearings do not spin smoothly, are noisy when rotated or have excessive end or axial play.

B. The bearing balls or rolling surfaces are pitted or worn.

C. The bearings are rusted, worn, cracked or show abnormal color due to overheating.

**NOTE:** Individual components in the frame housing are not available separately. Replace housing or complete starter/generator if damage exists in frame and field assembly.

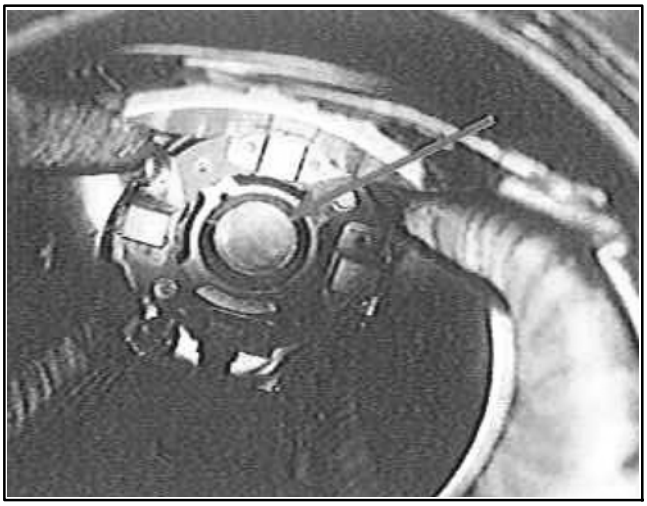

Figure 36

9. Remove nut, lock washer, flat washer and fiber washer from A1 and A2 terminals on commutator end head.

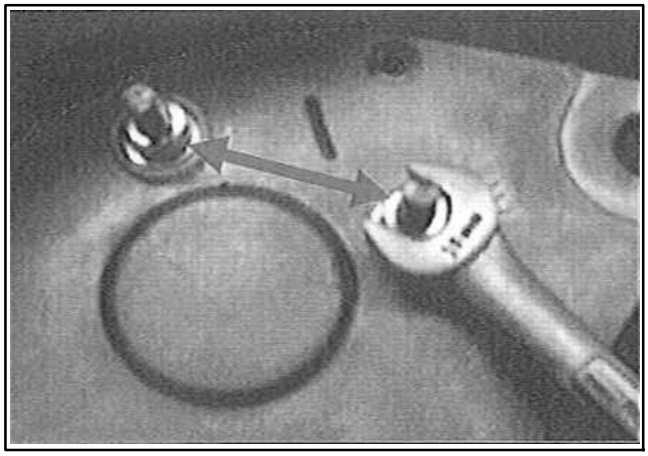

Figure 37

10. Remove two (2) screws that secure the brush box to the commutator end head. Carefully remove brush box from the commutator end head.

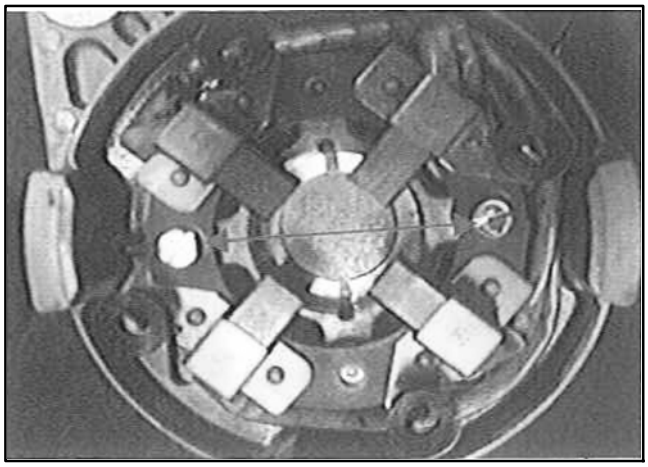

Figure 38

11. Remove brush assemblies from the brush box.

    Minimum brush length is **0.375 in (9.5 mm)**
    Maximum brush length is **0.790 in (20 mm)**

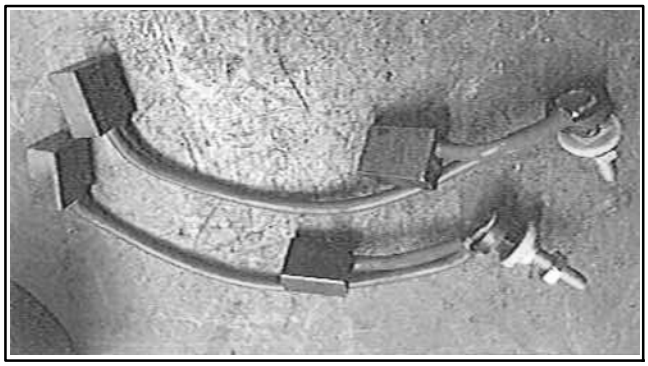

Figure 39

12. Assembly new brushes to the brush plate.

A. First, insert the brush with the short lead into one of the brush holders. Then rotate the brush plate 180° to insert the brush with the longer lead. Repeat for second brush assembly.

B. Be sure that terminal insulator is positioned on each terminal bolt after assembly. Also, be sure to have the brush springs against the side of the brushes so the brushes do not go into the brush box fully.

Figure 40

13. Verify the correct position of the brushes. If the brushes are not in the correct orientation, the starter/generator will not function.

A. Terminal A1 connects to brush boxes 2 and 4.

B. Terminal A2 connects to brush boxes 1 and 3.

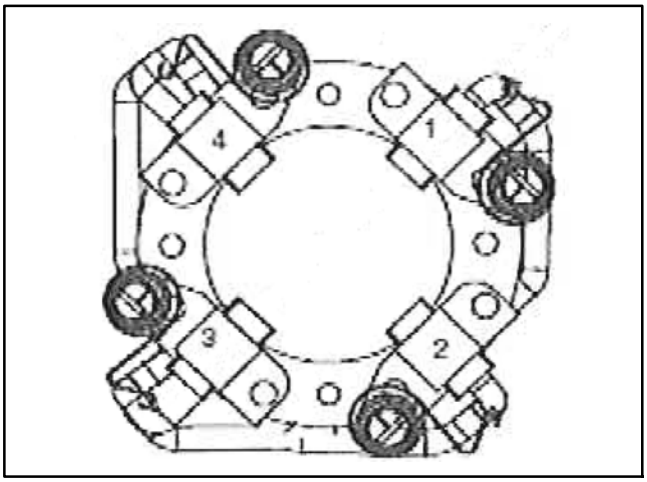


Figure 41

14. Assemble the brush box to the commutator end head. Make sure that the brush leads are dressed properly, that the leads are not pinched under the brush box and that the copper shunts do not contact the aluminum end head. Secure brush box to end head with two (2) screws. Torque screws from **22 to 26 in-lb (2.5 to 2.9 N-m)**.

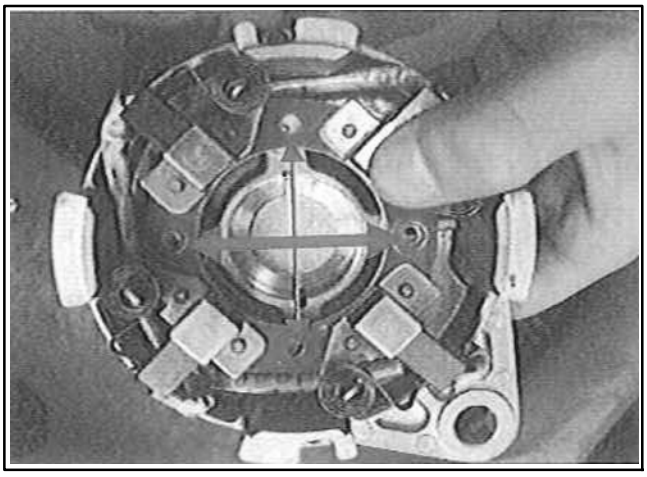

Figure 42

15.Secure A1 and A2 terminals to commutator end head with fiber washer, flat washer, lock washer and nut on each terminal. Torque nuts from **40 to 50 in-lb (4.6 to 5.6 N-m)**.

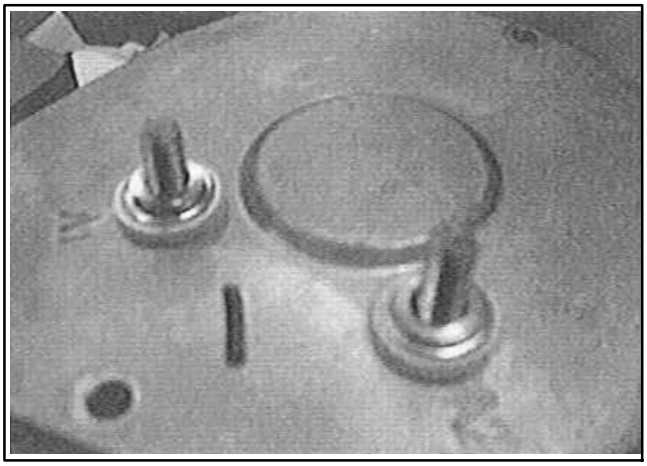

Figure 43

16.Secure commutator end head assembly to frame housing with two (2) screws. Use marks placed on end head and housing to properly orientate head. Torque screws from **49 to 66 in-lb (5.6 to 7.4 N-m)**.

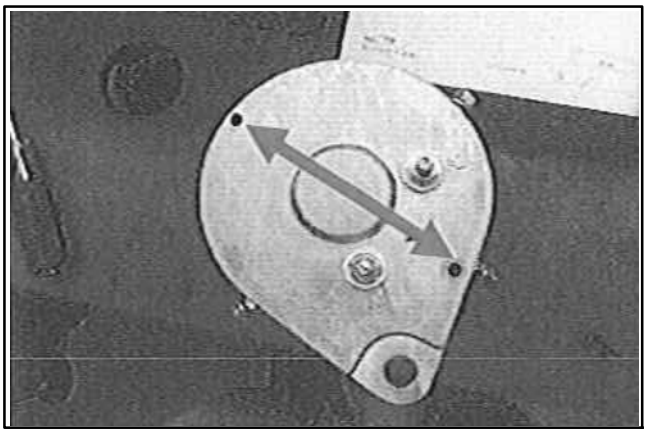

Figure 44

17.Position the starter/generator on the commutator end head and support the assembly to prevent damage to the terminals in the end head.

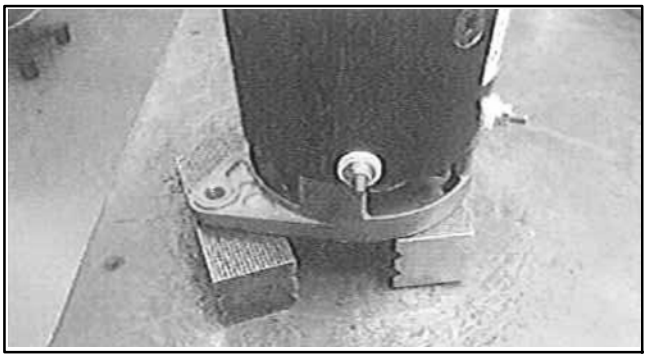

Figure 45

18. Make sure that brushes are pushed back in brush holders so they will not interfere with armature installation.

19. Position wave washer into bearing bore in commutator end head.

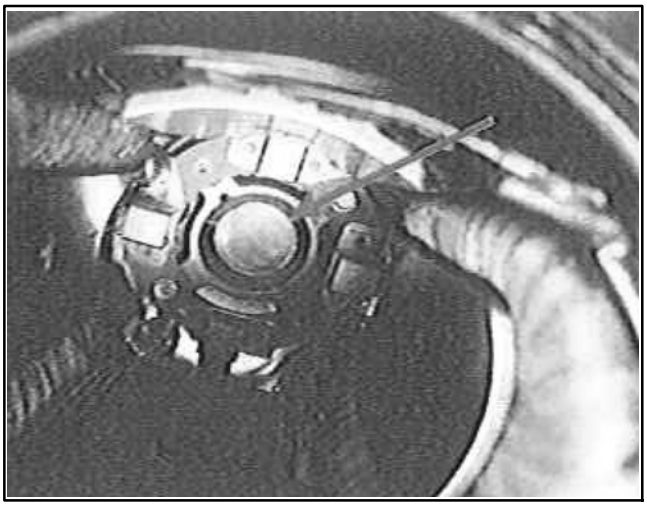

Figure 46

20. Carefully lower the armature and drive end head assembly into the frame housing making sure that armature bearing is inserted into bearing bore in commutator end head.

21. Use marks placed on drive end head and housing to properly orientate head. Secure drive end head to frame housing with two (2) screws. Torque screws from **49 to 66 in-lb (5.6 to 7.4 N-m)**.

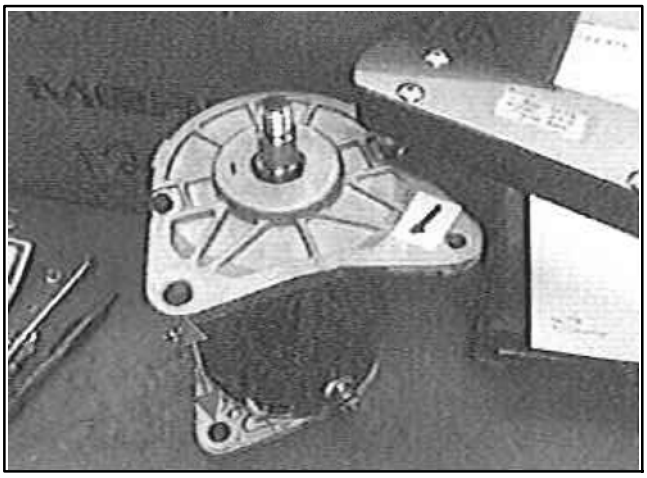

Figure 47

22. Release brushes and center the brush springs between the wire and the edge of the brush. Make sure that brushes move freely in brush holders.

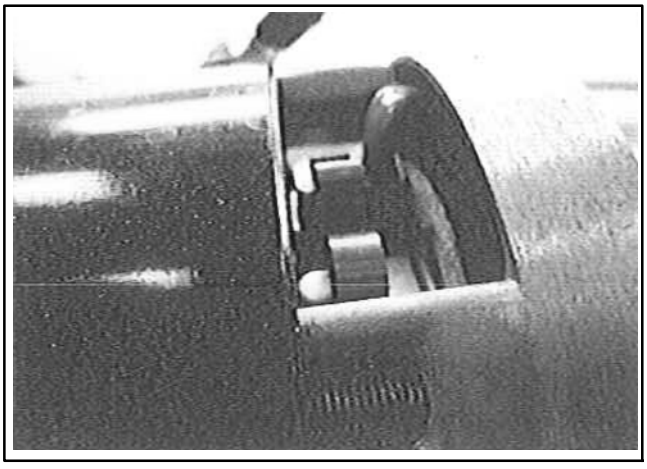

Figure 48

23. Install rubber plugs to the commutator end head. Make sure that the plug that includes a weep hole is placed as noted during disassembly.

24. Make sure that the armature rotates freely after assembly.

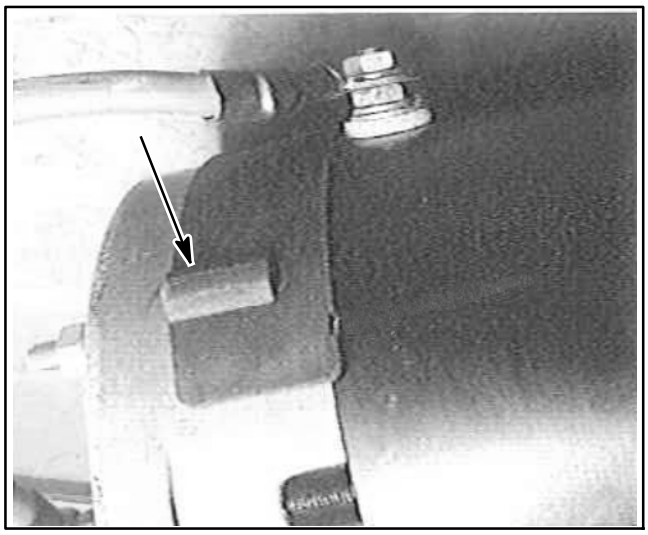

Figure 49

**Starter/Generator Specifications**

**NOTE:** Rework to the starter/generator must be performed by a properly trained technician using the correct tools and equipment for testing and reworking electrical motors and generators. It may be more economically feasible to replace the starter/generator than have it reworked.

| Detail | Specification |
|---|---|
| Armature Resistance at 75º (24º) | 0.0125 Ohms between bar 1 and 11 |
| Field Resistance at 75º (24º) | 0.0069 Series Ohms Total<br>3.20 Shunt Ohms Total |
| Maximum brush length | 0.790 in (20 mm) |
| Minimum brush length | 0.375 in (9.5 mm) |
| Commutator bars | 41 |
| Commutator original maximum diameter (new) | 1.780 in (45.2 mm) |
| Commutator minimum diameter for reslotting | 1.650 in (41.9 mm) |
| Commutator replacement diameter | 1.60 in (40.6 mm) |

## Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

**WARNING**

**POTENTIAL HAZARD:**
**Either the battery terminals or metal tools could short against metal vehicle components.**
**WHAT CAN HAPPEN:**
**Sparks can cause the battery gasses to explode.**
**Damaged cables could short against metal vehicle components and cause sparks.**
**HOW TO AVOID THE HAZARD:**
**When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the vehicle.**
**Always DISCONNECT the negative (black) battery cable before disconnecting the positive (red) cable.**
**Always CONNECT the positive (red) battery cable before connecting the negative (black) cable.**
**Do not allow metal tools to short between the battery terminals and metal parts of the vehicle.**
**Always keep the battery retaining components secure to protect the battery.**

**Battery Specifications**

BCI Group Size U1
300 Amp Cranking Performance at 0º F (–17.8ºC)
Reserve Capacity at 25 Amps and 80ºF (26.7ºC) is 28 Minutes

**Electrolyte Specific Gravity**

Fully charged: 1.265 corrected to 80ºF (26.7ºC)
Discharged: less than 1.240

**Battery Removal (Fig. 50)**

**IMPORTANT: Be careful to not damage terminal posts or cable connectors when removing the battery cables.**

1. Position vehicle on a level surface, set parking brake, turn ignition switch off and remove key.

2. Raise cargo box and secure with prop rod.

3. Disconnect negative (black) cable from battery first to prevent short circuiting the battery, other components or operator's hands. Then disconnect positive (red) cable.

4. Remove wing nuts and hold down rod that secure battery.

5. Make sure that filler caps are on tightly.

6. Remove battery from chassis to a service area. This will minimize possible battery damage and allow better access for battery inspection and service.

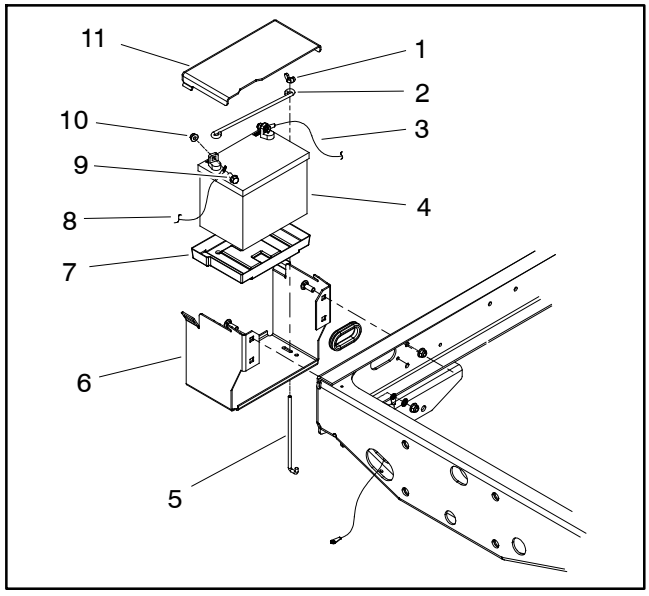


Figure 50

1. **Wing nut (2 used)**
2. **Hold down rod**
3. **Positive cable (red)**
4. **Battery**
5. **Post (2 used)**
6. **Battery base**
7. **Battery tray**
8. **Negative cable (black)**
9. **Flange screw (2 used)**
10. **Flange nut (2 used)**
11. **Battery cover**

**Battery Inspection and Maintenance**

**WARNING**

**POTENTIAL HAZARD:**
**Battery electrolyte contains sulfuric acid which is a deadly poison and it causes severe burns.**
**WHAT CAN HAPPEN:**
**If you carelessly drink electrolyte you could die or if it gets onto your skin you will be burned.**
**HOW TO AVOID THE HAZARD:**
**Do not drink electrolyte and avoid contact with skin, eyes or clothing. Wear safety glasses to shield your eyes and rubber gloves to protect your hands.**
**Fill the battery where clean water is always available for flushing the skin. Always RECONNECT the positive (red) battery cable before reconnecting the negative (black) cable.**
**Follow all instructions and comply with all safety messages on the electrolyte container.**

1. Check for cracks caused by overly tight or loose hold down rod. Replace battery if cracked and leaking.

2. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.

**IMPORTANT: Before cleaning the battery, tape or block the vent holes to the filler caps and make sure the caps are on tightly.**

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

5. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water to the bottom of the cap tubes (or fill line). Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

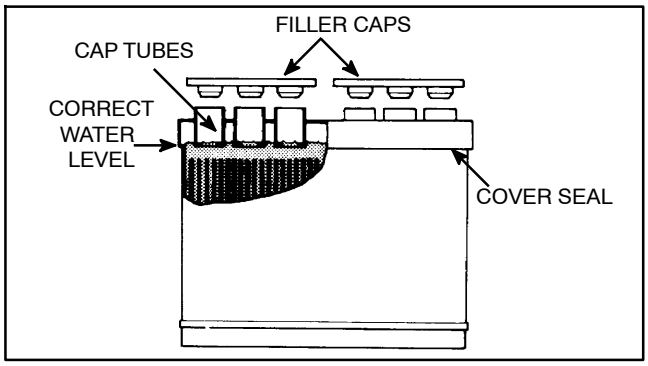

Figure 51

**Battery Installation (Fig. 50)**

**IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.**

1. Make sure the ignition switch and all accessories are off.

2. Make sure the battery tray is clean and repainted if necessary.

3. Make sure battery cables, battery connections and the battery hold down components are in good condition.

4. Set battery on the battery base with its posts toward the right side of the vehicle.

5. Secure positive cable (red) to positive battery post with flange screw and flange nut.

6. Secure battery with hold down rod and wing nuts.

7. Connect a digital multimeter (set to amps) between the negative battery post and the negative cable (black) connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

8. Secure negative cable (black) to negative battery post with flange screw and flange nut.

9. Apply battery terminal protector (Toro part number 107-0392) on battery posts and cable connectors to reduce corrosion after connections are made.

**Battery Testing**

1. Conduct a hydrometer test of the battery electrolyte:

**IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.**

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

| | | |
|---|---|---|
| Example: | Cell Temperature | 100°F |
| | Cell Gravity | 1.245 |
| | ADD (20° above 80°F) | 0.008 |
| | Correction to 80°F | 1.253 |

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

2. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

**CAUTION**

**Follow the battery load tester manufacturer's instructions when using a load tester.**

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.0 VDC, recharge the battery before load testing.

B. Make sure the battery terminals are free of corrosion.

C. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

D. Measure the temperature of the electrolyte in the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 150 amps (one half the Cranking Performance) for 15 seconds.

G. Take a battery voltage reading at 15 seconds, then remove the load. Record this test voltage reading.

H. Using the table below, determine the minimum test voltage for the cell temperature reading.

| Minimum Test Voltage | Battery Electrolyte Temperature | |
|---|---|---|
| 9.6 | 70°F (and up) | 21.1°C (and up) |
| 9.5 | 60°F | 15.6°C |
| 9.4 | 50°F | 10.0°C |
| 9.3 | 40°F | 4.4°C |
| 9.1 | 30°F | -1.1°C |
| 8.9 | 20°F | -6.7°C |
| 8.7 | 10°F | -12.2°C |
| 8.5 | 0°F | -17.8°C |

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

### Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

**CAUTION**

**Follow the battery charger manufacturer's instructions when using a battery charger.**

**NOTE:** Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open specific gravity or circuit voltage.

| Battery Charge Level | Specific Gravity | Open Circuit Voltage |
|---|---|---|
| 100% | 1.265 | 12.68 |
| 75% | 1.225 | 12.45 |
| 50% | 1.190 | 12.24 |
| 25% | 1.155 | 12.06 |
| 0% | 1.120 | 11.89 |

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

| Battery Reserve Capacity (Minutes) | Battery Charge Level (Percent of Fully Charged) | | | |
|---|---|---|---|---|
| | 75% | 50% | 25% | 0% |
| **80 or less** | **3.8 hrs @ 3 amps** | **7.5 hrs @ 3 amps** | **11.3 hrs @ 3 amps** | **15 hrs @ 3 amps** |
| 81 to 125 | 5.3 hrs @ 4 amps | 10.5 hrs @ 4 amps | 15.8 hrs @ 4 amps | 21 hrs @ 4 amps |
| 126 to 170 | 5.5 hrs @ 5 amps | 11 hrs @ 5 amps | 16.5 hrs @ 5 amps | 22 hrs @ 5 amps |
| 171 to 250 | 5.8 hrs @ 6 amps | 11.5 hrs @ 6 amps | 17.3 hrs @ 6 amps | 23 hrs @ 6 amps |
| above 250 | 6 hrs @ 10 amps | 12 hrs @ 10 amps | 18 hrs @ 10 amps | 24 hrs @ 10 amps |

**CAUTION**

**Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.**

**Charge battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive.**

**Keep open flame and electrical spark away from the battery. Do not smoke. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.**

**Nausea may result if the gases are inhaled.**

3. **Follow the battery charger manufacturer's instructions.** Connect charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

### Battery Storage

If the vehicle will be stored for more than 30 days, remove the battery and charge it fully. Either store it on the shelf or on the vehicle. Leave the cables disconnected if it is stored on the vehicle. Store the battery in a cool atmosphere to avoid quick deterioration of the charge in the battery. To prevent the battery from freezing, make sure it is fully charged.

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# Chapter 7

# Chassis

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# General Information

### Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Workman vehicle. Refer to the Operator's Manual for additional information when servicing the machine.

# Specifications

| Item | Description |
|---|---|
| Front Tire (Workman MD and MDX)<br>Pressure Range | (22 x 9.5 – 10, 2 ply)<br>8 to 22 PSI (56 to 151 kPa) |
| Rear Tire (Workman MD)<br>Pressure Range | (22 x 9.5 – 10, 2 ply)<br>8 to 22 PSI (56 to 151 kPa) |
| Rear Tire (Workman MDX)<br>Pressure Range | (24 x 12 – 10, 2 ply)<br>8 to 22 PSI (56 to 151 kPa) |
| Wheel Lug Nut Torque | 45 to 65 ft-lb (62 to 88 N-m) |
| Brake Fluid | DOT 3 |

# Special Tools

Order special tools from your Toro Distributor.

## Spanner Wrench

Use spanner wrench to rotate front shock absorber collar which changes the length of the shock spring to affect front wheel camber. Make sure that vehicle is jacked up off the ground to allow shock spring to be at full extension before using spanner wrench.

Toro Part Number: **TOR6010**

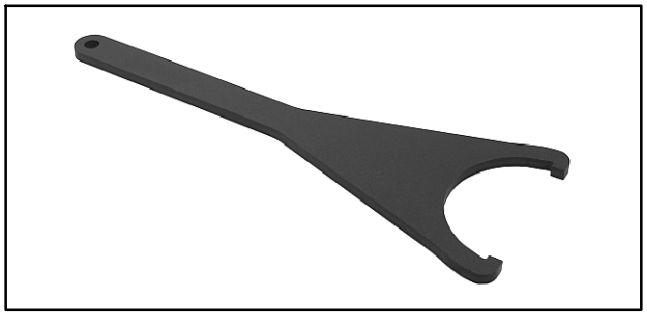

Figure 1

## Shock Spring Compressor

Use shock spring compressor to remove spring from front shock absorber.

Toro Part Number: **TOR6015**

Figure 2

# Troubleshooting

## Suspension and Steering

| Problem | Possible Cause |
|---|---|
| Front end is noisy. | Front wheel lug nuts are loose.<br>Front wheel bearings are loose or worn.<br>Front shocks are loose or worn.<br>Front end components (e.g. tie-rod, spindle, A-arm) are loose or worn.<br>Steering gearbox is damaged or worn. |
| Rear end is noisy. | Rear wheel lug nuts are loose.<br>Rear shocks are loose or worn.<br>Rear swing arm is loose.<br>Clutch or transaxle problem (see Chapter 5 - Drive Train). |
| Excessive steering play. | Front wheel lug nuts are loose.<br>Front wheel bearings are loose or worn.<br>Steering linkage is loose or worn.<br>Tie rod ends are worn.<br>Steering gearbox is damaged or worn.<br>Spindle bushings in A-arm are loose or worn. |
| Vehicle is unstable or wanders. | Tire pressure is low or uneven between tires.<br>Wheel lug nuts are loose.<br>Front wheel bearings are loose or worn.<br>Steering column bushings are worn.<br>Steering gearbox is damaged or worn.<br>Front wheel alignment (toe-in) is incorrect.<br>Rubber shock insert or spindle bushings in A-arm are loose or worn. |

## Suspension and Steering (continued)

| Problem | Possible Cause |
|---|---|
| Front end shimmies. | Front wheel lug nuts are loose.<br>Front wheel bearings are loose or worn.<br>Steering linkage is loose or worn.<br>Tie rod ends are loose or worn.<br>Front wheel alignment (toe–in) is incorrect.<br>Rubber shock insert or spindle bushings in A–arm are loose or worn. |
| Steering is hard. | Tire pressure is low or uneven between tires.<br>Steering linkage is binding or damaged.<br>Front wheel alignment (toe–in) is incorrect.<br>Steering gearbox is damaged or worn. |
| Vehicle pulls to one side when not braking. | Tire pressure is low or uneven between tires.<br>Front wheel alignment (toe–in) is incorrect.<br>Steering or suspension component may be damaged. |

## Brakes

| Problem | Possible Cause |
|---|---|
| Brake pedal goes to the floor. | Rear brake shoes are excessively worn.<br>Front brake pads are excessively worn.<br>Brake fluid level in master cylinder is low.<br>Brake fluid leak exists at hose, caliper or wheel cylinder.<br>Brake master cylinder is faulty. |
| Brake pedal is spongy. | Brake shoes are not burnished.<br>Air is trapped in brake lines.<br>Ground speed is too fast (see Chapter 5 – Drive Train).<br>Engine has excessive run–on when accelerator pedal is released due to carburetor not fully closing (see Engine Chapter). |

## Brakes (continued)

| Problem | Possible Cause |
|---|---|
| Brakes pull to either side. | Tire pressure is incorrect or uneven between tires.<br>Brake linings are contaminated.<br>Front wheel alignment (toe–in) is incorrect.<br>Brake shoes are distorted.<br>Tires on same axle are unmatched. |
| Brakes squeal. | Brake lining is glazed or saturated.<br>Shoe–to–shoe spring(s) is (are) weak or broken.<br>Brake shoes are distorted.<br>Anchor plate is bent.<br>Brake drums and shoes are dusty.<br>Brake drums are scored or out–of–round. |
| Brakes drag. | Parking brake is applied or incorrectly adjusted.<br>Shoe–to–shoe spring(s) is (are) weak or broken.<br>Brake pedal is binding.<br>Parking brake cable is binding.<br>Brake linings are saturated.<br>Brake drums or rotors are bent or out–of–round. |
| Brake pedal is hard to push. | Incorrect brake lining material.<br>Brake pedal linkage is binding. |
| Wheels lock–up when braking. | Brake linings are contaminated.<br>Brake linings are loose or damaged.<br>Wheel or transaxle bearings are damaged.<br>Shoe–to–shoe springs are weak.<br>Brake drums are grooved in the contact face with brake shoes. |
| Brakes fade. | Brake drums are overheated.<br>Brake linings are saturated. |
| Vehicle surges at slow speeds and chatters at fast speeds. | Brake drums are bent or out–of–round. |

# Adjustments

## Adjust Parking Brake

1. Pry the rubber cover off of the parking brake.

2. Loosen the set screw securing the knob to the parking brake lever (Fig. 1).

3. Rotate the knob until a force from 30 to 40 lb. (133 to 177 N) is required to actuate the lever.

4. Tighten the set screw and install the rubber cover.

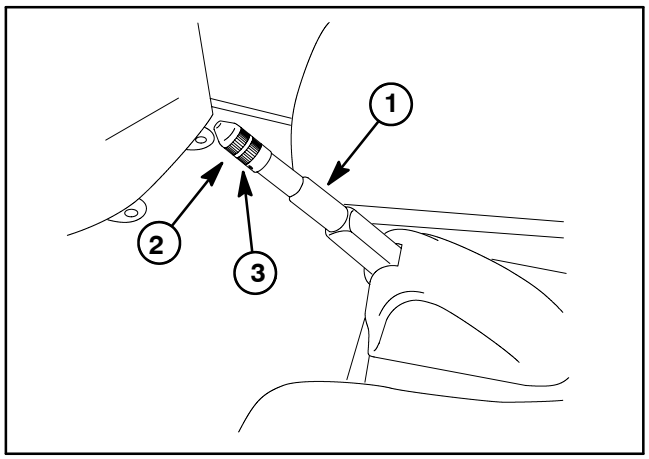


Figure 1

1. **Parking brake lever**
2. **Brake knob**
3. **Set screw**

## Adjust Front Wheel Camber

1. Adjust front tire pressures to 12 PSI (82 kPa) before checking front wheel camber.

2. Either add weight to the driver's seat equal to the average operator who will run the machine or have an operator on the vehicle operator's seat. The weight or operator must remain on the seat for the duration of this front wheel camber procedure.

3. On a level surface, roll the vehicle straight back from 6 to 10 feet (2 to 3 meters) and then straight forward to the original starting position. This will allow the suspension to settle into the normal operating position.

4. Make sure that the front wheels are facing straight ahead.

5. Measure the front wheel camber on both front wheels:

   A. Place a 90º square on the ground with the vertical edge touching the face of the tire (Fig. 4).

   B. From the same part of the rim, measure the distance from the top and bottom of the rim to the square. Record the two (2) measurements.

   C. The measurement at the bottom of the rim should be 0.090" (2.3 mm) larger than the top measurement. This measurement allows for a camber of 0+1/2 degree.

   D. Repeat measurement procedure for other front wheel.

6. If camber measurement for either wheel is incorrect, adjust shock absorber spring to correct camber for that wheel:

   A. Chock wheels to prevent the vehicle from moving. Use a jack to raise vehicle and allow shock absorber to extend. This will allow easier shock spring adjustment.

   B. Use spanner wrench (TOR6010: see Special Tools in this chapter) to rotate shock absorber collar which changes the length of the shock spring (Fig. 5). If the bottom camber measurement was too short, rotate the collar to reduce the length of the shock spring. If the bottom camber measurement was too long, rotate the collar to increase the length of the shock spring.

   C. Lower vehicle to level surface.

7. Repeat steps 2 through 6 until front wheel camber on both wheels is correct.

8. After camber adjustment, check front wheel toe-in (see Adjust Front Wheel Toe-in in this section).

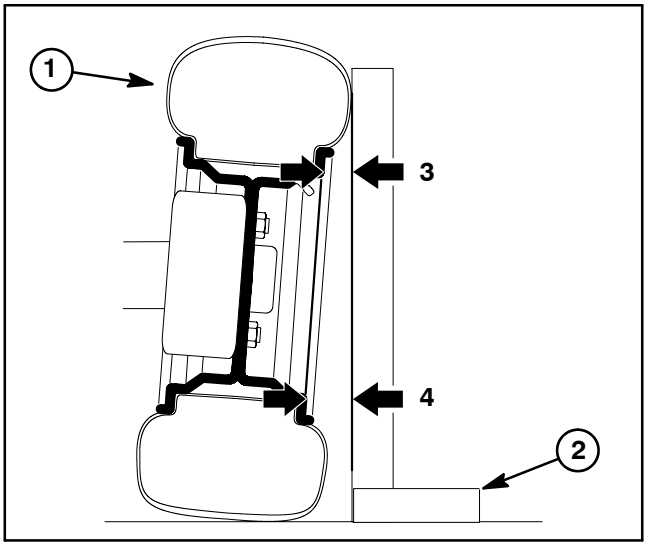


Figure 4

1. **Front wheel**
2. **90º square**
3. **Top measurement**
4. **Bottom measurement**

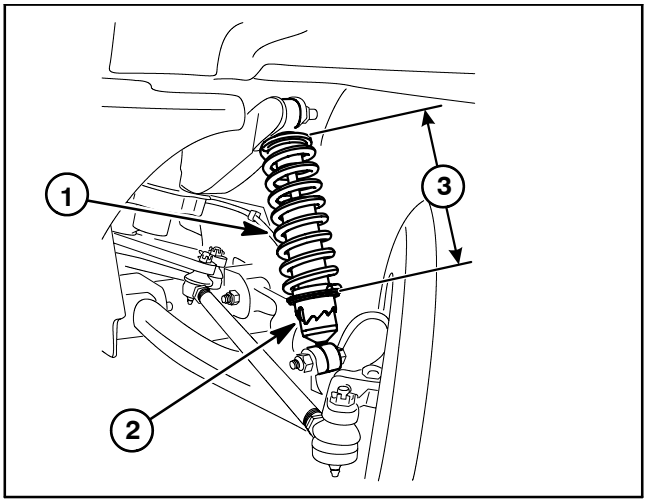


Figure 5

1. **Shock absorber spring**
2. **Collar**
3. **Spring length**

## Adjust Front Wheel Toe-in

**NOTE:** Before adjusting front wheel toe-in, make sure that front wheel camber is correctly adjusted (see Adjust Front Wheel Camber in this section).

1. Adjust front tire pressures to 12 PSI (82 kPa) before checking front wheel toe-in.

2. Either add weight to the driver's seat equal to the average operator who will run the machine or have an operator on the vehicle operator's seat. The weight or operator must remain on the seat for the duration of this front wheel toe-in procedure.

3. On a level surface, roll the vehicle straight back from 6 to 10 feet (2 to 3 meters) and then straight forward to the original starting position. This will allow the suspension to settle into the normal operating position.

4. Make sure that the front wheels are facing straight ahead.

5. Measure distance between the front tires at axle height at both the front and rear of the tires (Fig. 6). Front wheel toe-in should be from **0 to 1/4 inch (0 to 6 mm)**.

6. If the front wheel toe-in is incorrect, adjust as follows:

   A. Loosen jam nuts at both ends of tie rods (Fig. 7).

   B. Rotate both tie rods to move front of tire inward or outward.

   C. Tighten tie rod jam nuts when toe-in adjustment is correct.

7. Ensure that there is full steering travel in both directions.

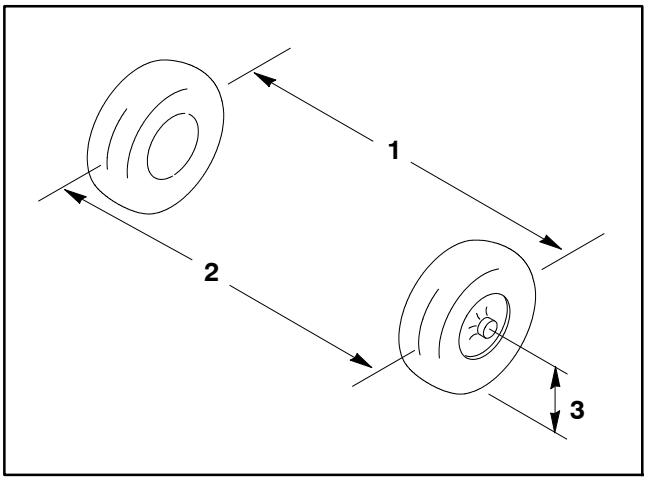


Figure 6

1. **Tire center line (back)**
2. **Tire center line (front)**
3. **Axle center line**

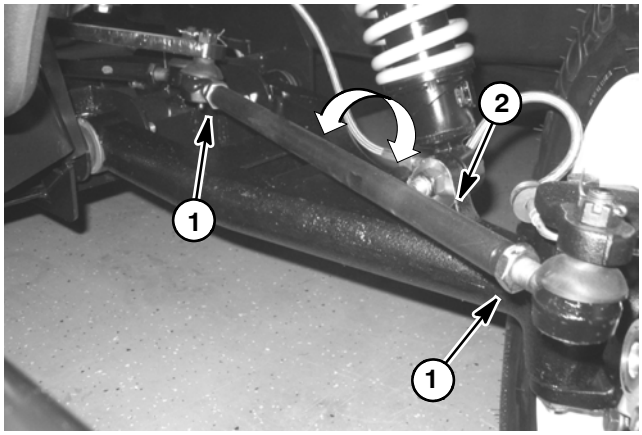


Figure 7

1. **Jam nut**
2. **Tie rod**

## Check Tire Pressure

See Specifications for tire pressure range for front and rear tires.

The air pressure needed is determined by the payload carried. **Lower** air pressure will provide less compaction, a smoother ride and fewer tire marks. Lower pressure should not be used for heavy payloads at higher speeds.

**Higher** pressures should be used for heavier payloads at higher speeds. Do not exceed the maximum tire pressure.

## Inspect Tires and Wheels

Operating accidents, such as hitting curbs, can damage a tire or rim and also disrupt wheel alignment. Inspect tire and rim condition after any accident.

Check wheels to ensure they are mounted securely. Torque wheel lug nuts in a crossing pattern from **45 to 65 ft-lb (62 to 88 N-m)**.

## Upper Steering

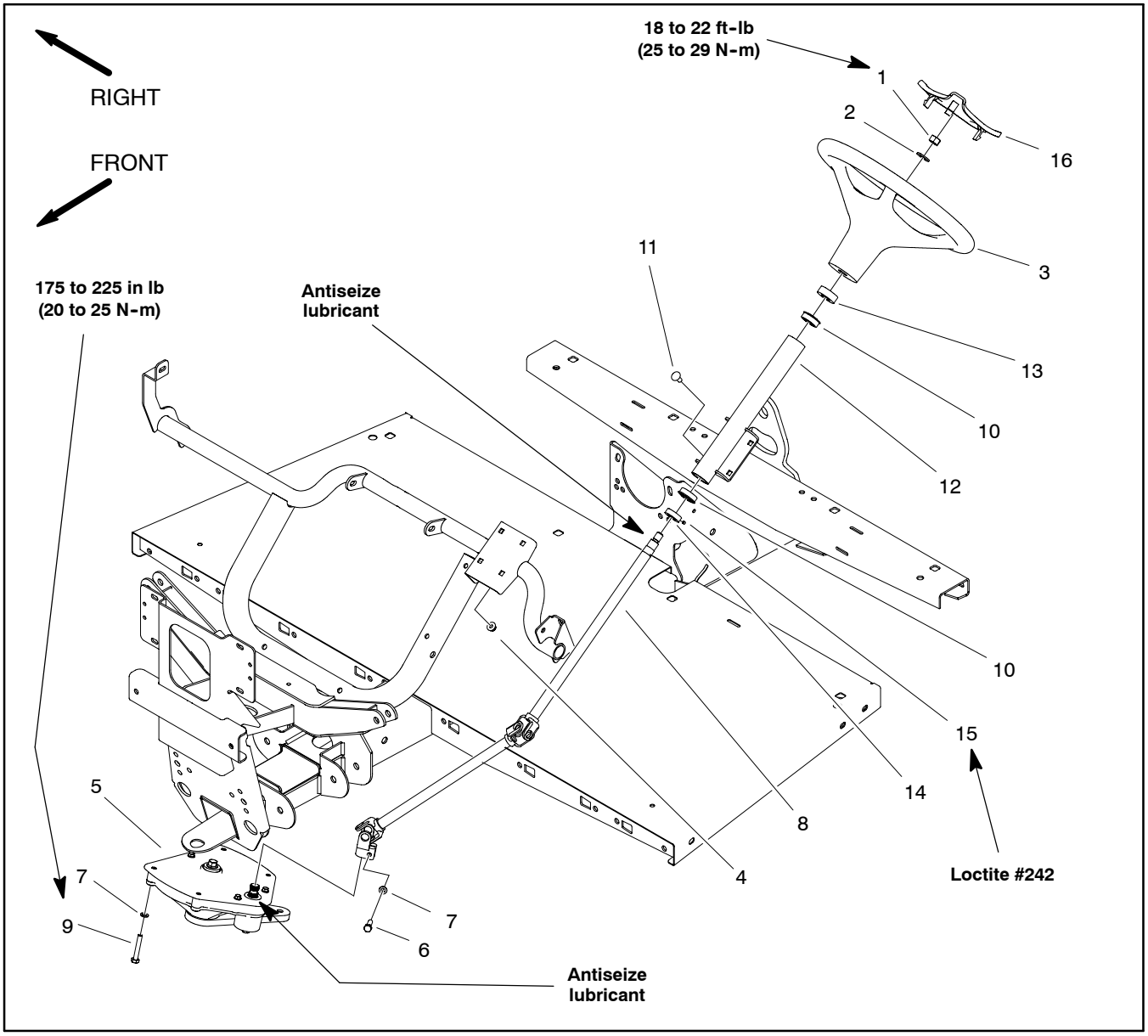


Figure 4

1. **Hex nut**
2. **Flat washer**
3. **Steering wheel**
4. **Flange nut (4 used)**
5. **Steering box assembly**
6. **Cap screw**
7. **Lock washer (6 used)**
8. **Steering shaft**
9. **Cap screw (4 used)**
10. **Bearing (2 used)**
11. **Carriage bolt (4 used)**
12. **Steering column**
13. **Dust cover**
14. **Collar**
15. **Set screw**
16. **Steering wheel cover**

### Disassembly (Fig. 4)

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Raise front hood to gain access to the steering components.

3. Carefully remove steering wheel cover from the steering wheel. Remove nut and flat washer securing the steering wheel to the steering shaft. Pull steering wheel from the shaft.

4. Remove cap screw and lock washer securing the lower steering shaft knuckle to the steering gearbox input shaft. Pull knuckle from the gearbox shaft.

5. Support steering column to prevent it from falling. Remove four (4) flange nuts and carriage screws securing the steering column to the mounting plate on the frame.

6. Remove dust cover (item 13) from the steering shaft. Replace cover if damaged. Slide steering shaft out of the steering column.

7. Disconnect both tie rods from the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Removal in this section).

8. Remove four (4) cap screws and lock washers that secure the steering gearbox to the tower plate on the front frame. Remove gearbox from the tower plate.

**Assembly (Fig. 4)**

1. Position steering gearbox to the tower plate of the front frame with the Pitman arm facing down and to the rear. The gearbox shaft must be to the left side of the tower.

2. Secure steering gearbox to the tower plate with four (4) cap screws and lock washers. Torque screws from **175 to 225 in-lb (20 to 25 N-m)**.

3. Make sure that collar (item 14) is positioned on steering shaft. Insert steering shaft up through the steering column.

4. Secure steering column to the mounting plate on the frame with four (4) carriage screws and flange nuts.

**NOTE:** Apply antiseize lubricant to the steering gearbox input shaft before installing to steering shaft knuckle.

5. Position knuckle of the lower steering shaft onto the gearbox input shaft. Secure knuckle to the steering gearbox shaft with cap screw and lock washer.

6. Make sure that collar (item 14) is just below steering column. If necessary, re-position collar on steering shaft. Apply Loctite #242 (or equivalent) to collar set screw and secure collar with set screw.

7. Place dust cover onto the steering shaft.

8. Connect both tie rods to the Pitman arm on the steering gearbox (see Lower Steering and Front Wheel Installation in this section).

**NOTE:** Apply antiseize lubricant to the steering shaft taper before installing the steering wheel.

9. Position front tires straight ahead. Slide steering wheel onto the steering shaft so that the leg of the "Y" formed by the wheel struts is directed towards the operator platform.

10. Secure steering wheel to shaft with flat washer and nut. Torque nut from **18 to 22 ft-lb (25 to 29 N-m)**. Install steering wheel cover to wheel.

11. Lower front hood.

12. Check front wheel alignment (see Adjust Front Wheel Toe-in in the Adjustments section of this chapter).

## Steering Gearbox

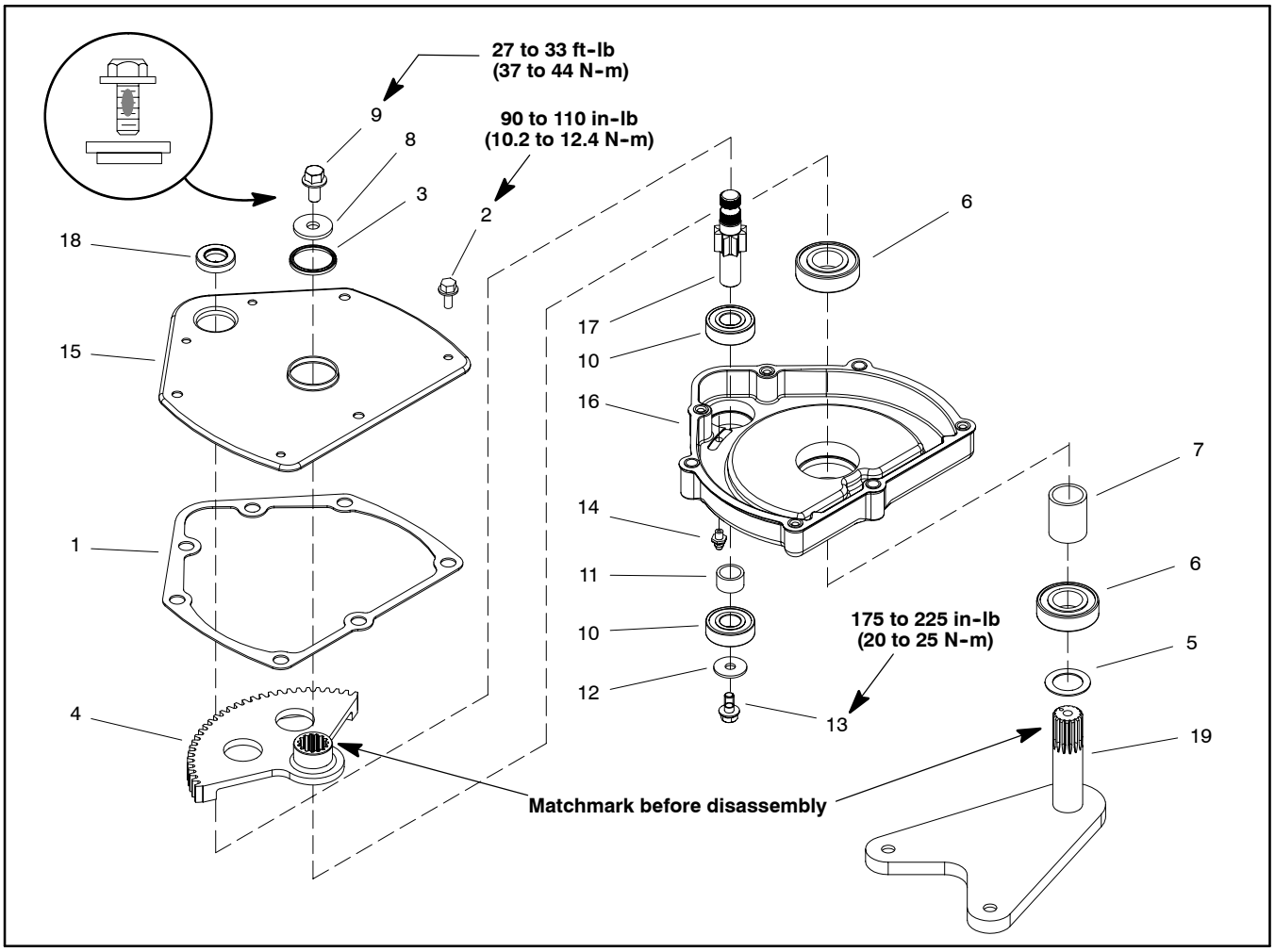


Figure 5

1. Gasket
2. Hex washer head screw (3 used)
3. Seal
4. Sector gear
5. Flat washer
6. Ball bearing
7. Output shaft spacer
8. Stepped washer
9. Flange head screw with patch lock
10. Ball bearing
11. Input shaft spacer
12. Flat washer
13. Flange head screw with patch lock
14. Lube fitting
15. Steering housing cover
16. Steering housing
17. Pinion gear
18. Oil seal
19. Pitman arm

**Disassembly (Fig. 5)**

**IMPORTANT: Do not reuse flange head screw with patch lock after it has been removed.**

1. Remove flange head screw with patch lock (item 9) and stepped washer (item 8) from Pitman arm. Discard flange head screw.

2. Remove flange head screw with patch lock (item 13) and flat washer (item 12) from pinion gear shaft. Discard flange head screw.

3. Remove three (3) hex washer head screws (item 2) securing the housing cover and gasket to the steering housing. Remove cover and gasket from the housing. Replace gasket if damaged.

4. Inspect gears. Sector and pinion gear teeth must be free of damage that prevents them of free movement.

5. Remove pinion gear (item 17) from the housing.

**IMPORTANT: Matchmark pitman arm shaft and sector gear. Their position is critical during reassembly.**

6. Separate Pitman arm (item 19) from the sector gear (item 4) and steering housing and remove from the housing.

7. Inspect bearings. Bearings must spin smoothly and be free of damage. Press bearings and spacer out of housing if necessary.

8. Inspect seals. Seals must be free of rips and tears. Replace seals if necessary.

**Assembly (Fig. 5)**

**IMPORTANT: Always replace ball bearings as a set.**

1. If ball bearings were removed:

   A. Press new bearing into housing from the inside first.

   B. Turn housing over. Insert spacer and press new bearing into housing.

2. If seals were removed, press new seals into housing. Seal lips should be facing up.

3. Place flat washer (item 5) onto shaft of the Pitman arm (item 19). Insert shaft into steering housing.

**IMPORTANT: The position of the Pitman arm and sector gear is critical during assembly. If either or both of these parts is replaced, make sure their alignment matches the matchmark position of the original gear and arm.**

4. Position sector gear (item 4) onto the spline of the Pitman arm shaft.

**IMPORTANT: Make sure sector gear is centered to the pinion gear.**

5. Insert pinion gear (item 17) into the small bearing in the steering housing.

6. Fill steering housing with number 2 general purpose grease. Make sure all gear teeth on the sector and pinion gears are covered with grease.

7. Place gasket and steering housing cover onto the housing. Secure cover to housing with three (3) hex washer head screws (item 2). Torque screws from **90 to 110 in-lb (10.2 to 12.4 N-m)**.

**IMPORTANT: Flange head screws with patch lock (items 9 and 13) should be replaced whenever they are removed.**

8. Secure stepped washer and flange head screw with patch lock (item 9) to the Pitman arm (item 8). Make sure to position stepped washer as shown in Figure 5. Torque screw from **27 to 33 ft-lb (37 to 44 N-m)**.

9. Secure flat washer (item 12) and flange head screw with patch lock (item 13) to the pinion gear shaft. Torque screw from **175 to 225 in-lb (20 to 25 N-m)**.

10. After assembly is completed, make sure that pitman arm rotates freely from stop to stop without binding.

## Lower Steering and Front Wheels

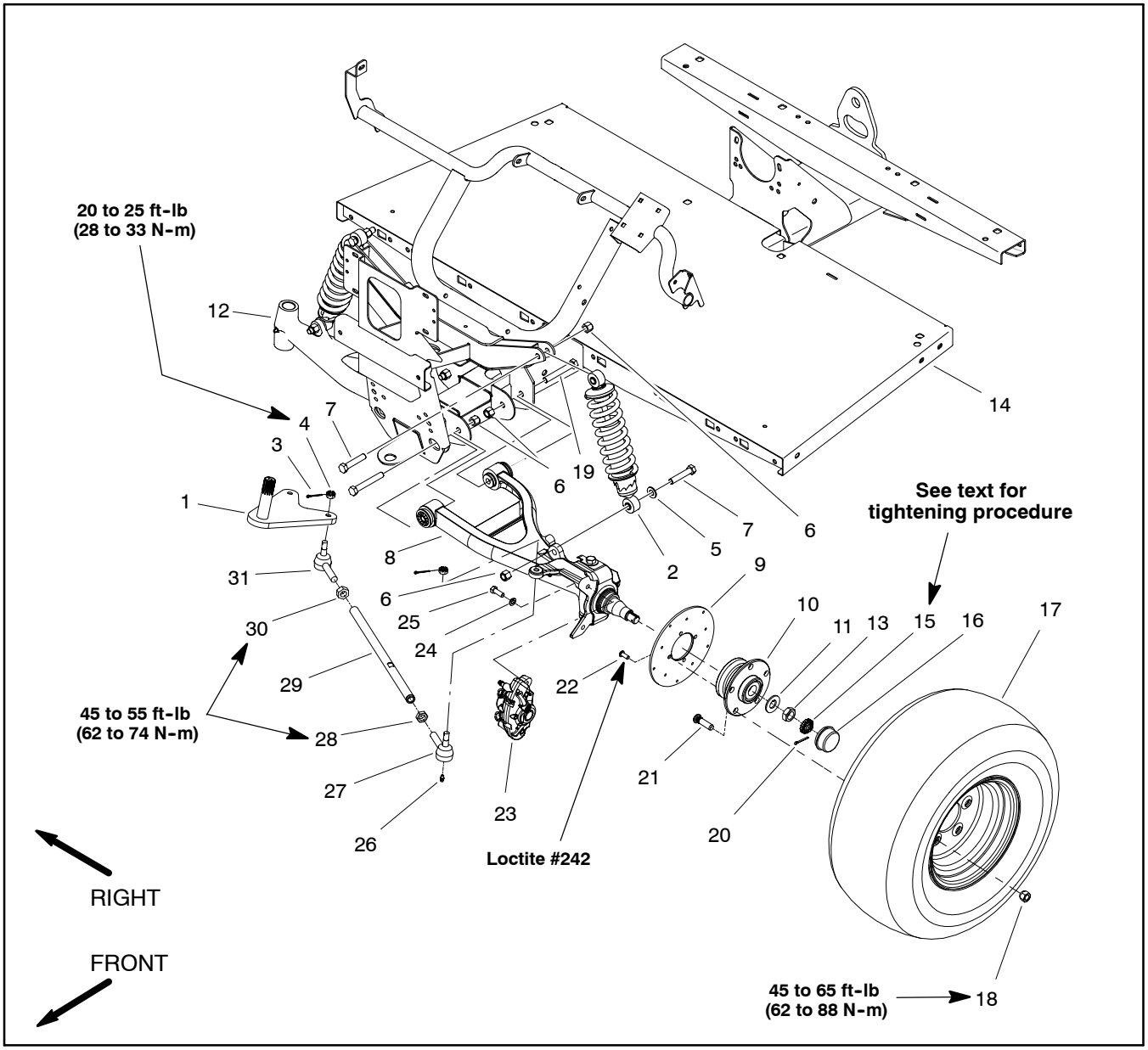


Figure 6

1. Steering gearbox pitman arm
2. Shock absorber (2 used)
3. Cotter pin
4. Slotted hex nut
5. Flat washer
6. Lock nut (3 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Brake rotor
10. Wheel hub assembly
11. Tab washer
12. RH A-arm
13. Jam nut
14. Front frame
15. Nut retainer
16. Dust cap
17. Wheel assembly
18. Lug nut (5 used per wheel)
19. Cap screw (2 used per A-arm)
20. Cotter pin
21. Wheel stud (5 used per hub)
22. Socket head screw (4 used per rotor)
23. Brake caliper (LH shown)
24. Lock washer (2 used per caliper)
25. Cap screw (2 used per caliper)
26. Grease fitting
27. Ball joint (LH threads)
28. Jam nut (LH threads
29. Tie rod
30. Jam nut (RH threads)
31. Ball joint (RH threads)

**Disassembly (Fig. 6)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Remove lug nuts and pull wheel assembly from machine.

4. Remove brake caliper from spindle (see Front Brake Caliper in this section). Position caliper away from wheel hub and spindle.

5. Carefully pry dust cap from wheel hub.

6. Remove cotter pin and nut retainer from spindle.

7. Remove jam nut that secures wheel hub to spindle. Slide wheel hub with bearings and brake rotor from spindle.

8. Disassemble the wheel hub (Fig. 7):

   A. Pull the seal out of the wheel hub.

   B. Remove bearings from both sides of the wheel hub. Clean bearings in solvent. Make sure bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

   C. If necessary, remove wheel studs and brake rotor from wheel hub.

9. Remove spindle (Fig. 8):

   A. Remove cotter pin and castle nut securing tie rod ball joint to the spindle. Separate ball joint from the spindle. Remove tie rod from steering gearbox pitman arm if necessary.

   B. Remove lock nut and cap screw securing the spindle to the A-arm. Separate spindle from A-arm.

   C. Locate and remove thrust washer from bottom of kingpin sleeve in A-arm and brake hose clip from top of A-arm. Remove kingpin sleeve from A-arm if necessary.

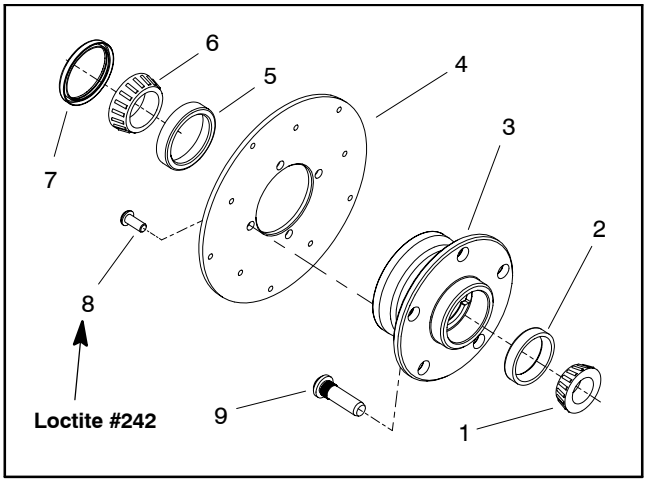


Figure 7

1. **Outer bearing cone**
2. **Outer bearing cup**
3. **Wheel hub**
4. **Brake rotor**
5. **Inner bearing cup**
6. **Inner bearing cone**
7. **Seal**
8. **Socket screw (4 used)**
9. **Wheel stud (5 used)**

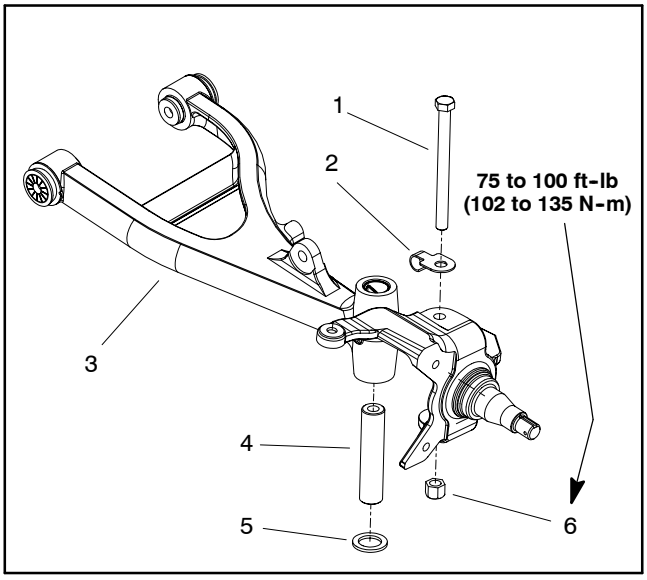


Figure 8

1. **Cap screw**
2. **Brake hose clip**
3. **A-arm (LH shown)**
4. **Kingpin sleeve**
5. **Thrust washer**
6. **Lock nut**

**Assembly (Fig. 6)**

1. Install spindle as follows (Fig. 8):

   A. Make sure king pin sleeve is positioned into the pivot hub of the A-arm. Sleeve must extend through the bottom of the hub.

   B. Place thrust washer onto the bottom of the king pin sleeve. Then place spindle over the A-arm hub, king pin sleeve and thrust washer.

   **NOTE:** Make sure cap screw is inserted down through the spindle and A-arm hub.

C. Install brake hose clip onto cap screw. Secure spindle to A−arm hub with cap screw and lock nut. Torque fasteners from **75 to 100 ft−lb (102 to 135 N−m)**.

2. Install tie rod:

   A. Insert tie rod ball joints down through the spindle and up through the Pitman arm. Secure with castle nuts.

   B. Torque castle nuts from **20 to 25 ft−lb (28 to 33 N−m)** to secure ball joint while aligning castle nut slot with hole in ball joint stud. If necessary to align holes, castle nut torque may be slightly more than specification. Install cotter pin.

3. Assemble wheel hub (Fig. 7):

   A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

   B. Pack both bearings with grease. Install inner bearing into the cup on inboard side of the wheel hub.

   **IMPORTANT: The wheel hub seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the inner bearing.**

   C. Lubricate the inside of the new seal and press it into the wheel hub.

   D. If brake rotor was removed, position rotor to hub with chamfered edge toward hub. Apply Loctite #242 (or equivalent) to socket head screws and secure rotor to hub.

4. Slide wheel hub assembly onto spindle. Install outer bearing, tab washer and jam nut onto spindle.

5. Rotate the wheel by hand and tighten the jam nut from **75 to 100 in-lb (8.5 to 11.3 N−m)** to set the bearings. Then, loosen the nut until the hub has end play.

6. Again, rotate the wheel by hand and tighten the jam nut from **15 to 20 in-lb (1.7 to 2.3 N−m)**.

7. Position nut retainer over jam nut and install cotter pin through spindle shaft hole. Install dust cap to hub.

8. Install brake caliper to spindle (see Front Brake Caliper in this section).

9. Install wheel assembly with valve stem facing out.

10. Lower machine to ground.

11. Torque wheel lug nuts in a crossing pattern from **45 to 65 ft−lb (62 to 88 N−m)**.

12. Align steering and toe−in (see Adjust Front Wheel Toe−in in the Adjustments section of this chapter).

13. Lubricate tie rod ball joints and king pin.

## Front Shock Absorbers

**Shock Removal (Fig. 13)**

**IMPORTANT: Any adjustment to the shock spring preload will affect the front wheel camber (see Adjust Front Wheel Camber in the Adjustments section of this chapter). Do not make shock spring adjustment without checking front wheel camber.**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Support a-arm to prevent it from moving after the shock is removed.

4. Remove lock nuts, cap screws and flat washer that secure shock to frame and a-arm. Remove shock absorber from vehicle.

**NOTE:** Use spanner wrench TOR6010 (see Special Tools in this chapter) if spring preload requires adjustment. If the spring is to be removed from the shock absorber, shock spring compressor tool TOR6015 (see Special Tools in this chapter) can be used.

**Shock Installation (Fig. 13)**

1. Position shock absorber to frame and a-arm brackets.

2. Secure shock absorber to vehicle.

   A. Slide upper cap screw through frame mounting holes and upper shock eye.

   B. Slide lower cap screw through flat washer, lower shock eye and a-arm mounting hole.

   C. Secure cap screws with lock nuts.

3. Lower vehicle to ground.

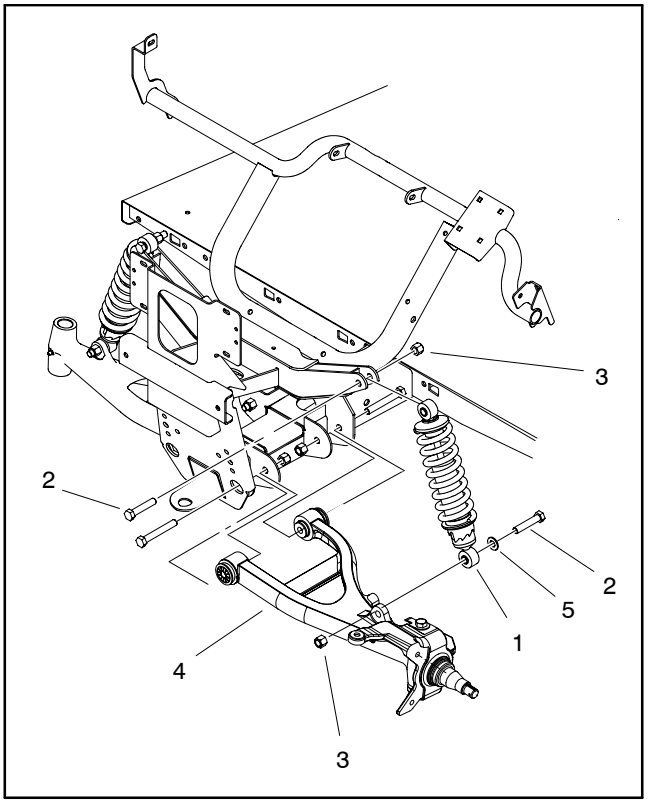


Figure 13

1. **Shock absorber**
2. **Cap screw**
3. **Lock nut**
4. **A-arm (LH shown)**
5. **Flat washer**

## A-arms and Front Suspension

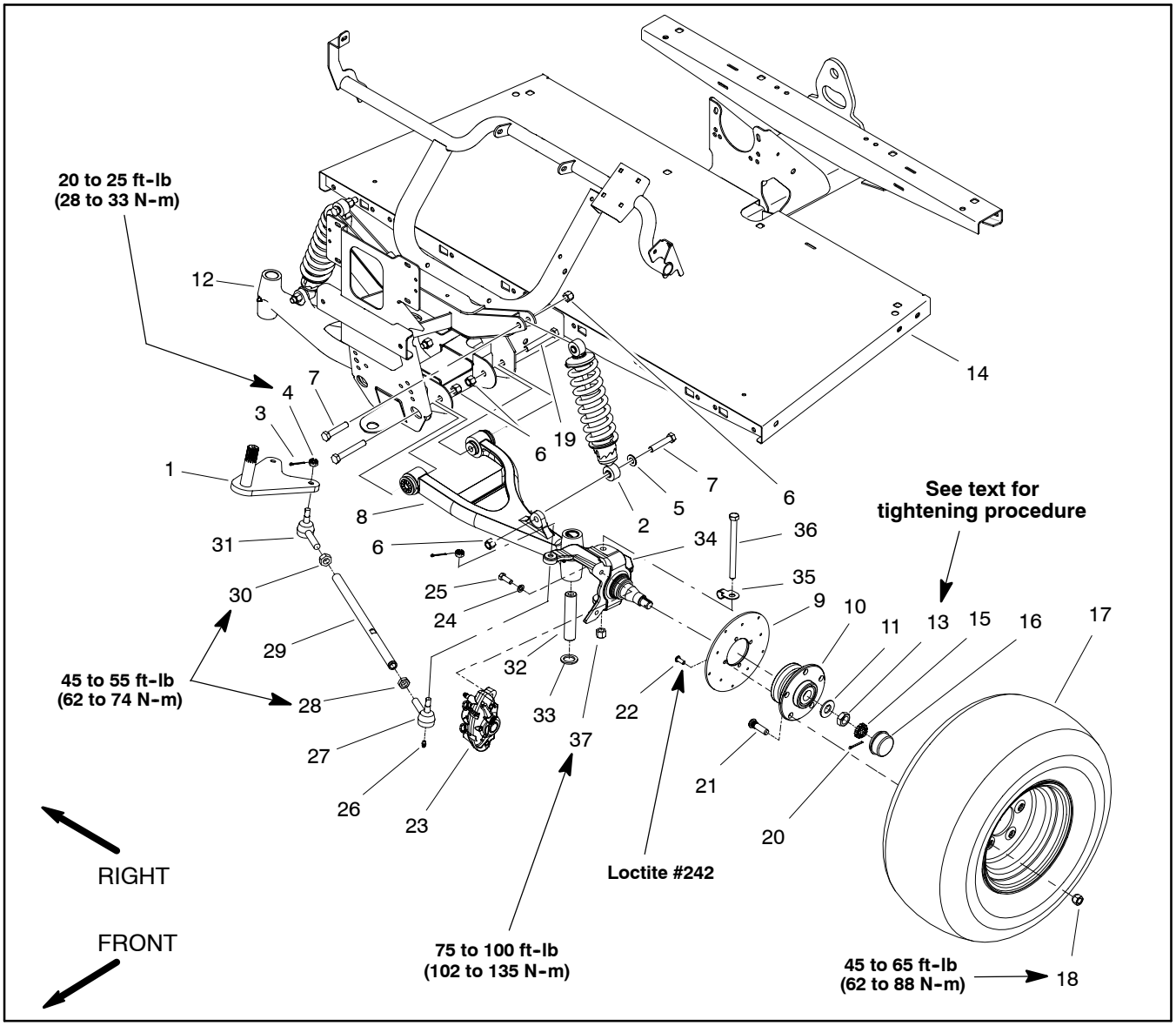


Figure 9

1. Steering gearbox pitman arm
2. Shock absorber (2 used)
3. Cotter pin
4. Slotted hex nut
5. Flat washer
6. Lock nut (3 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Brake rotor
10. Wheel hub assembly
11. Tab washer
12. RH A-arm
13. Jam nut
14. Front frame
15. Nut retainer
16. Dust cap
17. Wheel assembly
18. Lug nut (5 used per wheel)
19. Cap screw (2 used per A-arm)
20. Cotter pin
21. Wheel stud (5 used per hub)
22. Socket screw (4 used per rotor)
23. Brake caliper (LH shown)
24. Lock washer (2 used per caliper)
25. Cap screw (2 used per caliper)
26. Grease fitting
27. Ball joint (LH threads)
28. Jam nut (LH threads
29. Tie rod
30. Jam nut (RH threads)
31. Ball joint (RH threads)
32. Kingpin sleeve
33. Thrust washer
34. Spindle (LH shown)
35. Brake hose clip
36. Cap screw
37. Lock nut

**A-arm Removal (Fig. 9)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Chock wheels not being jacked up. Jack front wheel off the ground and support vehicle with appropriate jack stand beneath the frame.

3. Remove front wheel and spindle from A-arm (see Lower Steering and Front Wheel Removal in this section).

4. Remove cap screw (item 7), flat washer (item 5) and lock nut (item 6) that secure lower end of shock absorber to A-arm.

5. Support A-arm to prevent it from falling.

6. Remove both cap screws (item 19) and lock nuts (item 6) that secure A-arm to frame. Pull A-arm from frame.

7. If necessary, remove flange bushings and straight bushings from A-arm bores (Fig. 10).

**A-arm Installation (Fig. 9)**

1. If bushings were removed from A-arm, press new bushings fully into bore of A-arm (Fig. 10).

2. Position A-arm to the frame. Secure A-arm to the frame with cap screws (item 19) and lock nuts (item 6). Insert front screw from front of machine and rear screw from rear of machine. Do not fully tighten nuts.

3. Position lower end of shock absorber to A-arm and insert cap screw (item 7) with flat washer (item 5) from rear of shock. Secure with lock nut (item 6).

4. Fully tighten lock nuts (item 6) to secure A-arm to machine frame.

5. Install spindle and front wheel to the A-arm (see Lower Steering and Front Wheel Installation in this section).

6. Lower machine to ground. Make sure that wheel lug nuts are properly torqued in a crossing pattern from **45 to 65 ft-lb (62 to 88 N-m)**.

7. Align front wheel toe-in (see Adjust Front Wheel Toe-in in the Adjustments section of this chapter).

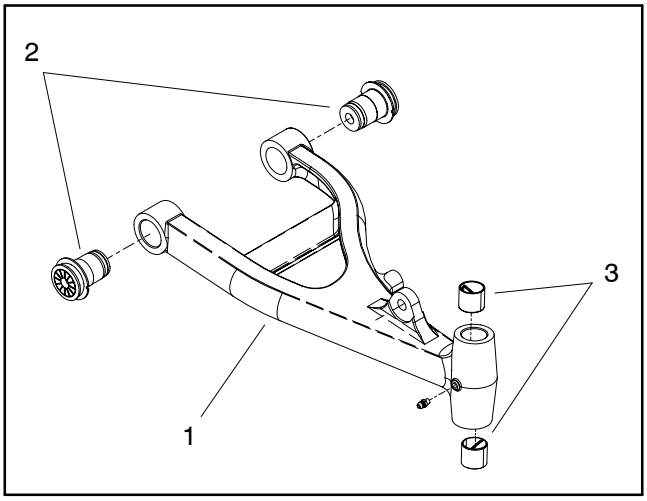


Figure 10

1. **A-arm**
2. **Flange bushing**
3. **Straight bushing**

## Frame Pivot Yoke

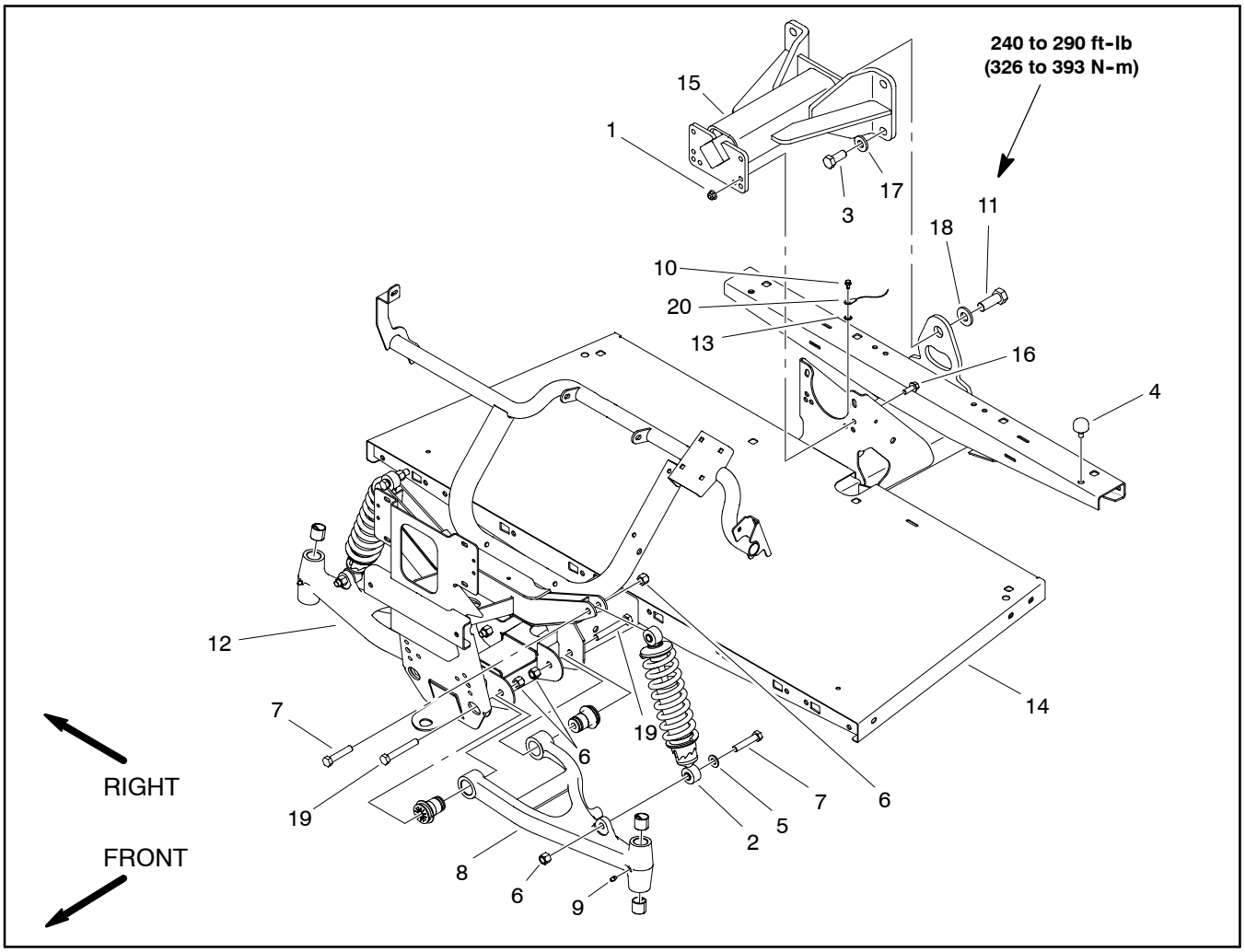


Figure 11

1. Flange nut (4 used)
2. Shock absorber (2 used)
3. Cap screw (4 used)
4. Rubber bumper
5. Flat washer
6. Lock nut (4 used per side)
7. Cap screw (2 used per shock)
8. LH A-arm
9. Grease fitting (1 used per arm)
10. Screw
11. Cap screw
12. RH A-arm
13. Lock washer
14. Front frame
15. Pivot yoke
16. Flange head screw (4 used)
17. Flat washer (4 used)
18. Hardened washer
19. Cap screw (2 used per arm)
20. Ground cable

**Pivot Yoke Removal (Fig. 11 and 12)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Remove cargo box from the rear frame (see Cargo Box Removal in this section).

3. Remove seat base from the front frame (see Seat Base Removal in this section).

**WARNING**

**Make sure all tires are chocked to prevent the machine from moving. Before removing the pivot yoke, make sure front and rear frames are supported with jack stands. Support both the front and back of each frame.**

4. Remove four (4) cap screws and flat washers securing the pivot yoke to the rear frame.

5. Remove cap screw and hardened washer securing the pivot yoke to the front frame tab.

**WARNING**

**Support pivot yoke while removing it from the front frame to prevent dropping and causing serious injury and damage to the machine.**

6. Remove four (4) flange head screws and flanged lock nuts securing the pivot yoke to the front frame. Remove pivot yoke from the machine.

**Pivot Yoke Installation (Fig. 11 and 12)**

**WARNING**

**Support pivot yoke while installing it to the front frame to prevent dropping and causing serious injury and damage to the machine.**

1. Position pivot yoke to the front frame so the diamond pattern faces up. Secure yoke to front frame with four (4) flange head screws and flanged lock nuts. Tighten lower two (2) fasteners first, then tighten upper two (2) fasteners.

2. Secure pivot yoke to the front frame tab with cap screw and hardened washer. Torque cap screw from **240 to 290 ft-lb (326 to 393 N-m)**.

3. Secure pivot yoke to the rear frame with four (4) cap screws and flat washers.

4. Install seat base to the front frame (see Seat Base Installation in this section).

5. Install cargo box to the rear frame (see Cargo Box Installation in this section).

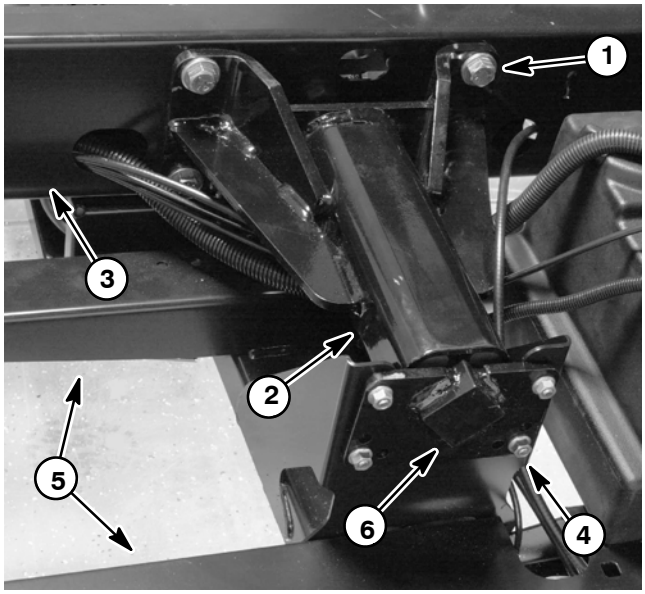


Figure 12

1. **Cap screw & flat washer**
2. **Pivot yoke**
3. **Rear frame**
4. **Flange lock nut**
5. **Front frame**
6. **Diamond pattern**

## Swing Arm

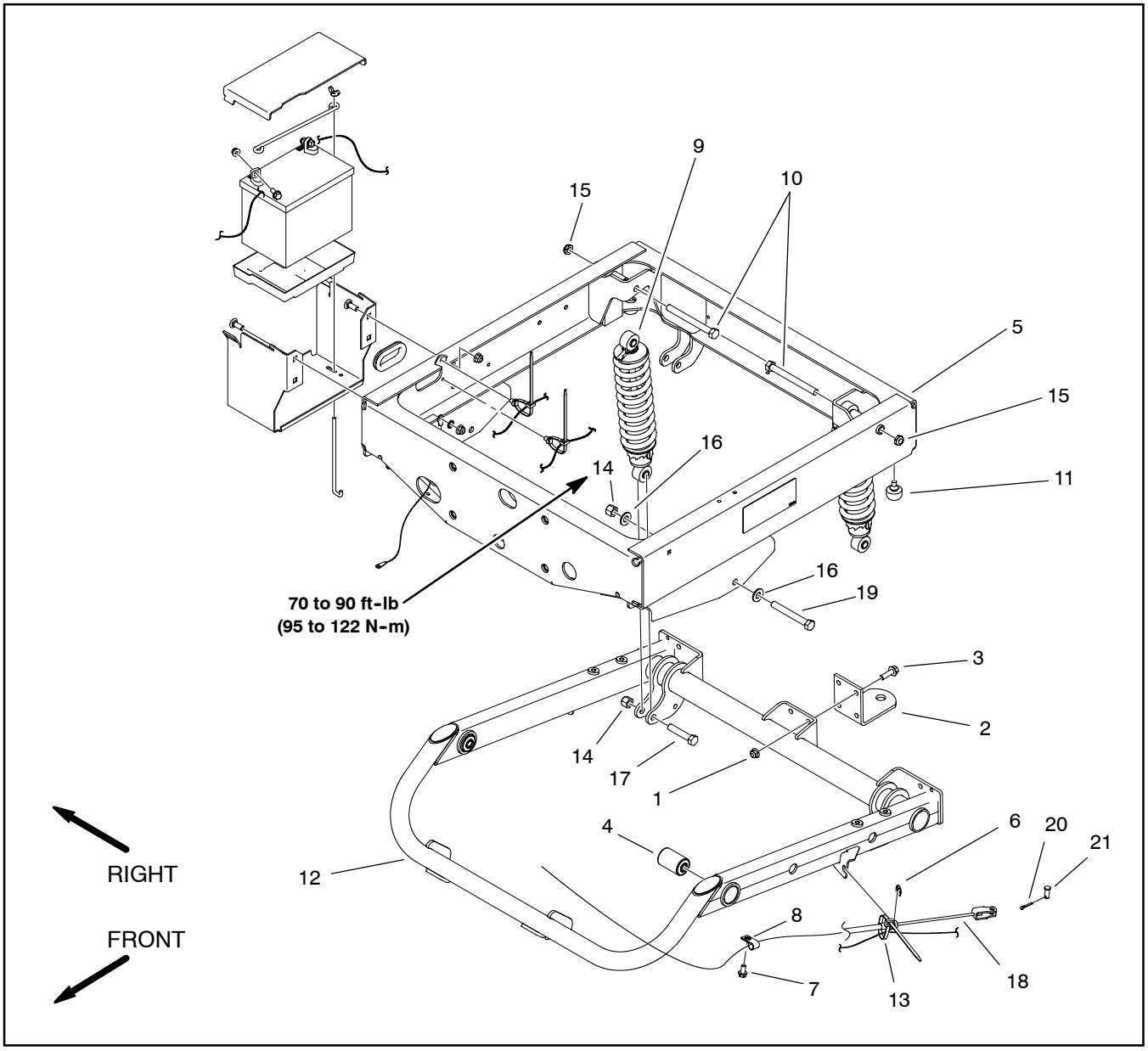


Figure 13

1. **Flange nut (4 used)**
2. **Hitch**
3. **Flange head screw (4 used)**
4. **Bushing (2 used)**
5. **Rear frame**
6. **Retaining ring (2 used)**
7. **Washer head screw (2 used)**
8. **R-clamp (2 used)**
9. **Rear shock assembly (2 used)**
10. **Cap screw (2 used)**
11. **Rubber bumper (2 used)**
12. **Swing arm**
13. **Cable tie**
14. **Lock nut (4 used)**
15. **Lock nut (2 used)**
16. **Thrust washer (4 used)**
17. **Cap screw (2 used)**
18. **Parking brake cable (2 used)**
19. **Cap screw (2 used)**
20. **Cotter pin (2 used)**
21. **Clevis pin (2 used)**

**Removal (Fig. 13)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Raise and support cargo box with prop rod.

3. Remove muffler from machine (see Exhaust System Removal in the Service and Repairs section of Engine Chapter).

4. Disconnect parking brake cables from rear brake levers and swing arm. Remove cable ties that secure rear brake lines to swing arm.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

5. Jack up both sides of the frame enough to lower swing arm and engine tray assembly.

A. Chock the front and rear of both front tires to prevent the vehicle from moving.

B. After raising the machine, support both sides of the frame with appropriate jack stands positioned just in front of the rear axle tubes. This will allow the swing arm and engine tray assembly to be lowered from the vehicle.

**CAUTION**

**When lowering swing arm and engine tray assembly, make sure hoist can support the total weight of the engine, transaxle, engine tray and other attached components. Total weight is approximately 325 pounds (148 kg).**

6. Attach hoist to the engine tray to allow swing arm, engine and transaxle to be lowered from the vehicle. Make sure hoist is attached to hold the full weight of the swing arm, engine, transaxle and tray.

7. Remove cap screw and lock nut that secure both shock absorbers to swing arm.

8. Remove cap screws, thrust washers and lock nuts that secure swing arm to machine frame.

**IMPORTANT: Take care to not damage the engine, transaxle, fuel hoses, electrical harness or other parts while lowering the swing arm and engine tray assembly.**

9. Carefully, lower swing arm and engine tray assembly just enough to allow clearance for swing arm removal.

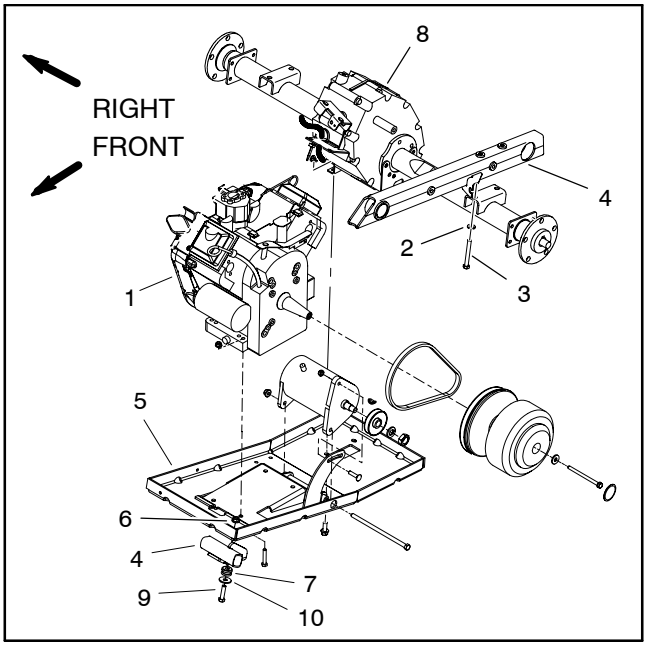


Figure 14

1. Engine
2. Washer (4 used)
3. Cap screw (4 used)
4. Swing arm
5. Engine tray
6. Flange nut (2 used)
7. Mount (2 used)
8. Transaxle
9. Cap screw (2 used)
10. Washer (2 used)

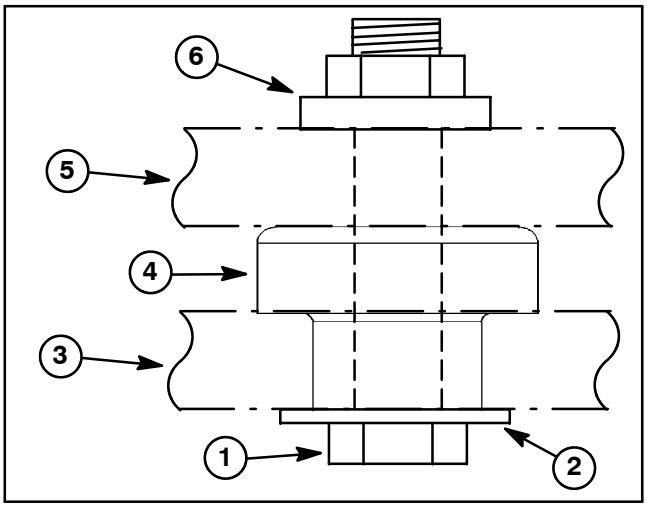


Figure 15

1. Cap screw
2. Flat washer
3. Swing arm bracket
4. Isolation mount
5. Engine tray
6. Flange nut

10. Support swing arm and engine tray assembly in this slightly lowered position to prevent it from shifting or falling.

11. Remove both flange nuts, flat washers and cap screws that secure the engine tray to the swing arm (Fig. 14).

12. Remove four (4) cap screws and flat washers that secure the transaxle to the swing arm (Fig. 14).

13. Remove swing arm from assembly.

**Installation (Fig. 13)**

1. Position swing arm to engine tray assembly.

2. Make sure that isolation mounts are positioned in the swing arm so that the flange is positioned between the swing arm bracket and engine tray location (Fig. 15).

3. Secure engine tray to the swing arm with cap screws, flat washers and flange nuts (Fig. 14).

4. Secure transaxle to swing arm with four (4) cap screws and flat washers (Fig. 14).

**IMPORTANT: Take care to not damage the engine, transaxle, fuel hoses, electrical harness or other parts while raising the swing arm and engine tray assembly.**

5. Carefully, raise swing arm and engine tray assembly to the machine frame. Align swing arm pivots to frame mounting points.

6. Secure swing arm to machine frame with cap screws, thrust washers and lock nuts. Torque lock nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

7. Secure both shock absorbers to swing arm with cap screw and lock nut. Insert cap screw from the inside of the swing arm brackets.

8. Lower machine to ground.

9. Connect parking brake cables to rear brake levers and swing arm.

10. Install muffler to machine (see Exhaust System Installation in the Service and Repairs section of Engine Chapter).

11. Lower and secure cargo box.

12. Check parking brake operation and adjust if necessary (see Adjust Parking Brake in the Adjustments section of this chapter).

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## Parking Brake

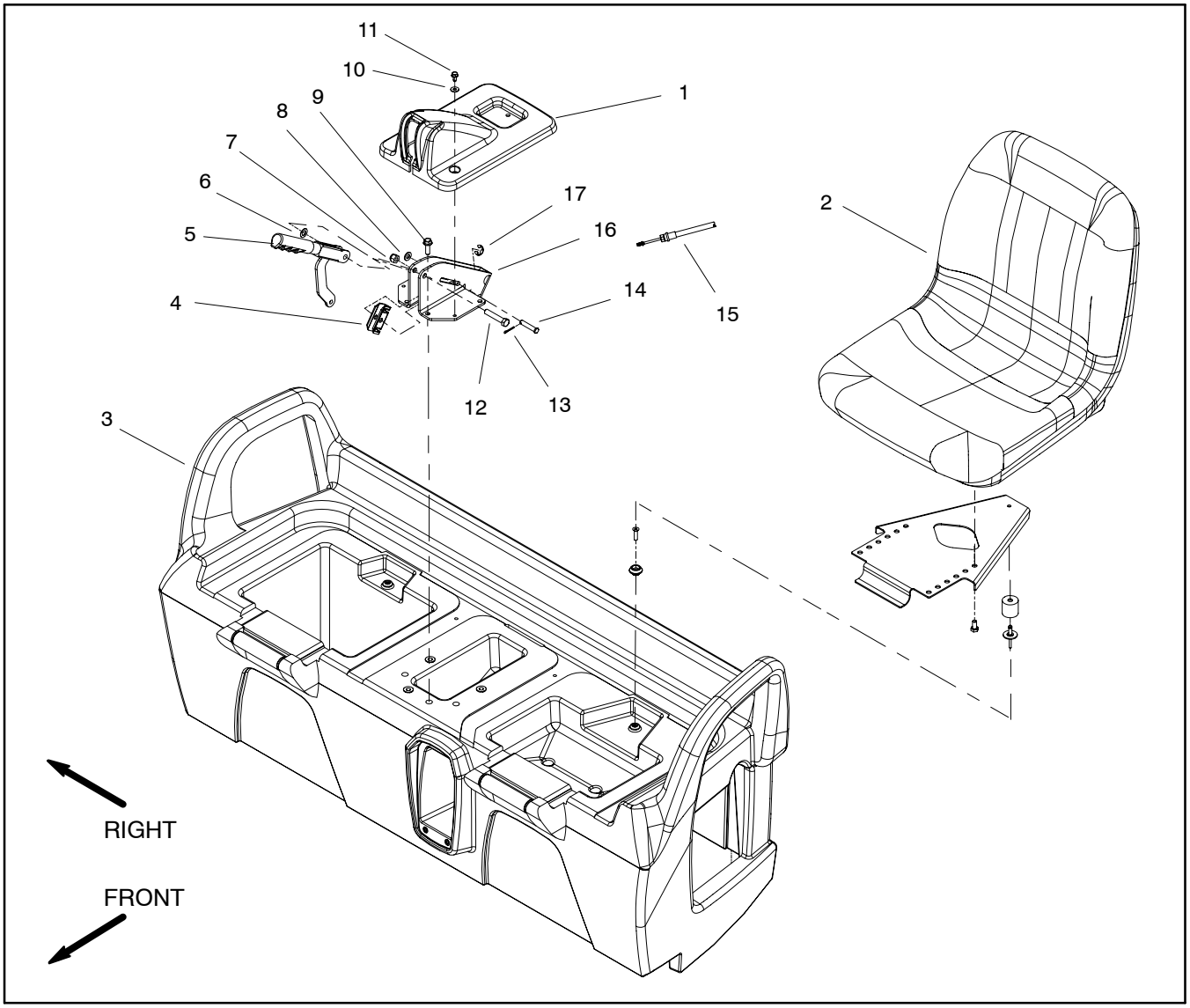


Figure 16

1. **Parking brake cover**
2. **Operator seat**
3. **Seat base**
4. **Cable equalizer bracket**
5. **Parking brake lever**
6. **Curved washer**
7. **Lock nut**
8. **Flat washer**
9. **Flange head screw (4 used)**
10. **Flat washer (2 used)**
11. **Screw (2 used)**
12. **Cap screw**
13. **Cotter pin**
14. **Clevis pin**
15. **Parking brake cable (2 used)**
16. **Parking brake support**
17. **Cable retaining ring (2 used)**

**Disassembly (Fig. 16)**

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Chock wheels to prevent the machine from moving.

2. Disconnect both brake cables from rear of machine (Fig. 17):

   A. Remove cotter pin and clevis pin that secures each brake cable end to brake lever.

   B. Remove retaining ring that secures each brake cable to frame.

   C. Remove screw and flange nut that secure each R−clamp to rear frame.

3. Note routing of brake cables for assembly purposes.

4. Remove parking brake cover from seat base.

5. Remove four (4) flange head screws that secure parking brake support to seat base.

6. Carefully remove parking brake support and brake cables from machine. Take care to not damage brake cables while removing them from seat base opening.

7. Remove brake cables from parking brake support and cable equalizer bracket using Figure 16 as a guide.

**Assembly (Fig. 16)**

1. Secure brake cables to parking brake support and cable equalizer bracket using Figure 16 as a guide.

2. Route brake cables through seat base opening taking care to not damage cables. Position parking brake support to seat base.

3. Secure parking brake support to seat base with four (4) flange head screws.

4. Position brake cables to rear brake assemblies using cable routing noted during disassembly.

5. Secure brake cables to rear of machine (Fig. 17):

   A. Secure each R−clamp to rear frame with screw and flange nut.

   B. Secure each brake cable to frame with retaining ring.

   C. Secure each brake cable end to brake lever with clevis pin and cotter pin.

6. Check parking brake operation and adjust if necessary (see Adjust Parking Brake in the Adjustments section of this chapter).

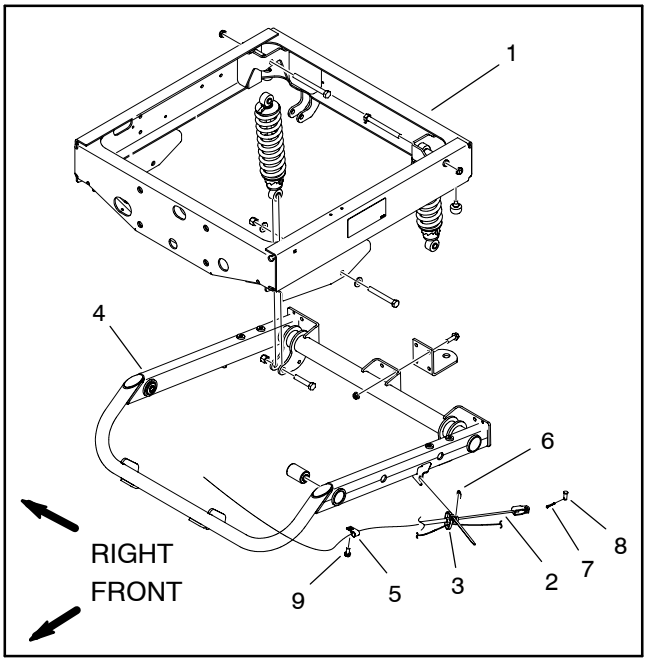


Figure 17

1. **Rear frame**
2. **Brake cable**
3. **Cable tie**
4. **Swing arm**
5. **R−clamp**
6. **Retaining ring**
7. **Cotter pin**
8. **Clevis pin**
9. **Washer head screw**

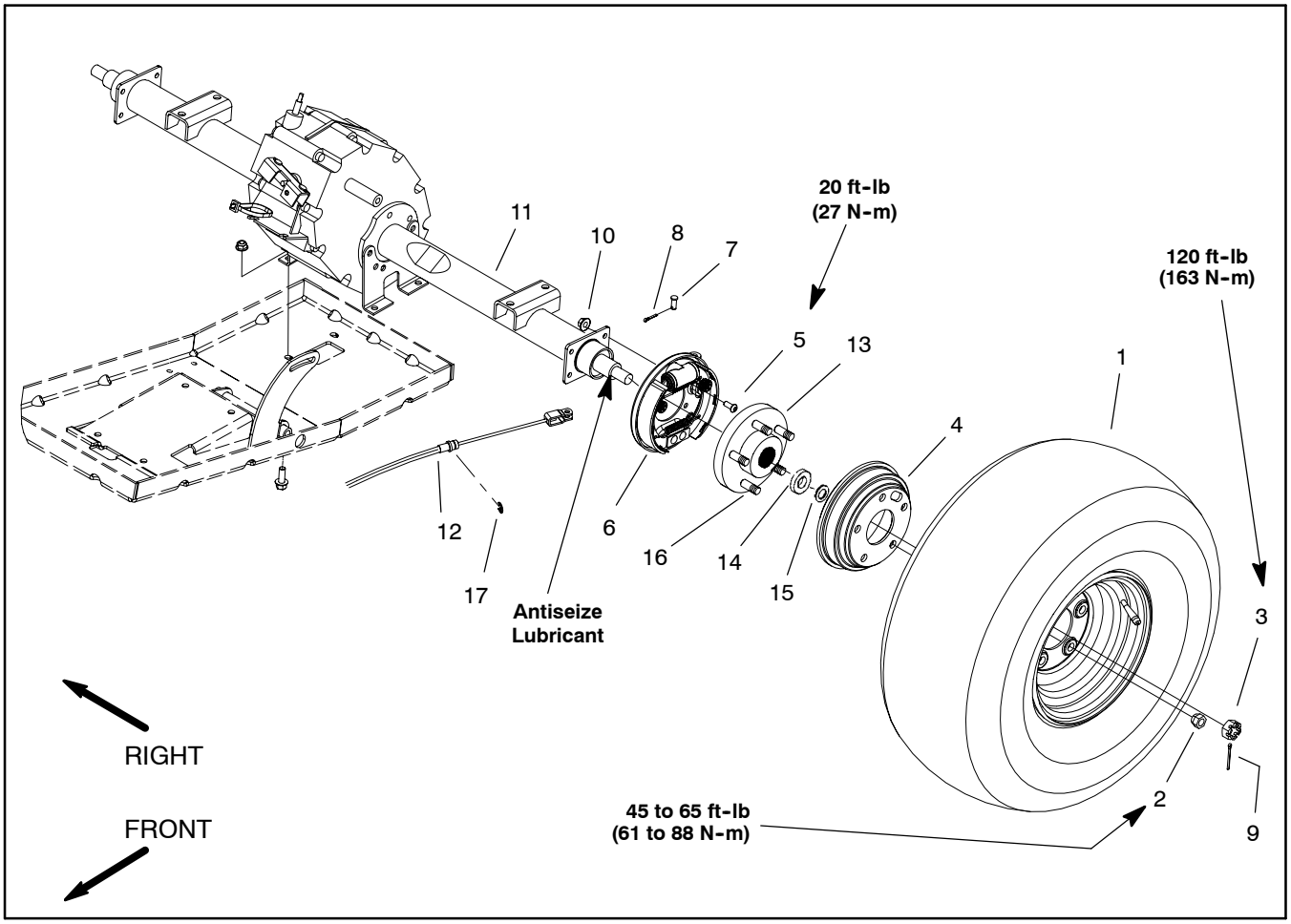


Figure 18

1. **Wheel assembly**
2. **Lug nut (5 used per hub)**
3. **Castle nut**
4. **Brake drum**
5. **Socket head screw (4 used per brake)**
6. **Brake assembly (LH shown)**
7. **Clevis pin**
8. **Cotter pin**
9. **Cotter pin**
10. **Flange lock nut (4 used per brake)**
11. **Transaxle**
12. **Parking brake cable (2 used)**
13. **Wheel hub**
14. **Washer**
15. **Spring washer**
16. **Wheel stud (5 used per hub)**
17. **Retaining ring**

**Removal (Fig. 18)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Chock wheels not being jacked up. Lift rear wheel off the ground using a jack and support vehicle with appropriate jack stand beneath the frame.

3. Remove five (5) lug nuts, wheel assembly and brake drum from the wheel hub.

4. Remove cotter pin from the castle nut and transaxle shaft. Remove castle nut, spring washer and washer from the shaft. Remove the wheel hub from the shaft.

**NOTE:** The brake assembly can be removed from the transaxle shaft for disassembly.

5. If required, remove brake assembly as follows:

   A. Remove cotter pin and clevis pin securing the parking brake cable to the parking brake lever on the rear of the brake assembly.

   B. Clean hydraulic brake line area of brake assembly to prevent contamination. Loosen and disconnect brake line from wheel cylinder. Plug brake line and position it away from brake assembly. Discard two (2) banjo washers.

C. Remove four (4) socket head screws and flange lock nuts that secure the brake assembly to the transaxle.

D. Remove brake assembly from the transaxle.

**Installation (Fig. 18)**

**IMPORTANT: Parking brake levers must be positioned above the transaxle mount. When positioned correctly, brake lever will point toward the rear of the axle.**

1. Position brake assembly to the transaxle. Secure backing plate of the brake assembly to the transaxle with four (4) socket head screws and flanged lock nuts. Torque screws to **20 ft-lb (27 N-m)**.

2. Position new banjo washer on each side of brake line fitting (Fig. 19). Insert banjo bolt into fitting and thread into wheel cylinder. Torque banjo bolt from **15 to 21 ft-lb (21 to 28 N-m)**.

3. Secure parking brake cable to the brake lever with clevis pin and cotter pin.

**IMPORTANT: Do not get antiseize lubricant onto brake shoes.**

4. Apply light coat of antiseize lubricant to the transaxle shaft splines.

5. Secure wheel hub to the shaft with washer, spring washer and castle nut.

6. Torque castle nut **120 ft-lb (163 N-m)**. If slot in nut does not align with hole in transaxle shaft, tighten nut to align next slot with hole in shaft. Castle nut torque should not exceed 200 ft-lb (271 N-m).

7. Secure castle nut to shaft with cotter pin.

8. Slide brake drum onto wheel hub.

9. Position wheel assembly to the machine with valve stem facing out and secure with five (5) lug nuts.

10. Lower machine to ground.

11. Torque lug nuts in a crossing pattern from **45 to 65 ft-lb (62 to 88 N-m)**.

12. Check parking brake operation. Adjust parking brake if necessary (see Parking Brake Adjustment in the Adjustments section of this chapter).

13. Bleed brakes (see Bleed Brake System in this section).

**CAUTION**

**After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

14. Check brake operation.

**Burnish Brake Shoes**

Sintered metal linings may not provide maximum brake stopping distance after brake shoes are replaced. It is necessary to burnish new brake shoe linings.

**IMPORTANT: Do not drive machine with the brakes applied. The brake shoe linings will overheat.**

**IMPORTANT: During brake burnishing procedure, do not allow the brakes to lock up. Allow brakes to cool between applications.**

1. Drive machine while making 6 to 7 normal stops at about 200 ft (60 m) intervals while traveling at 10 to 15 mph (16 to 24 KPH).

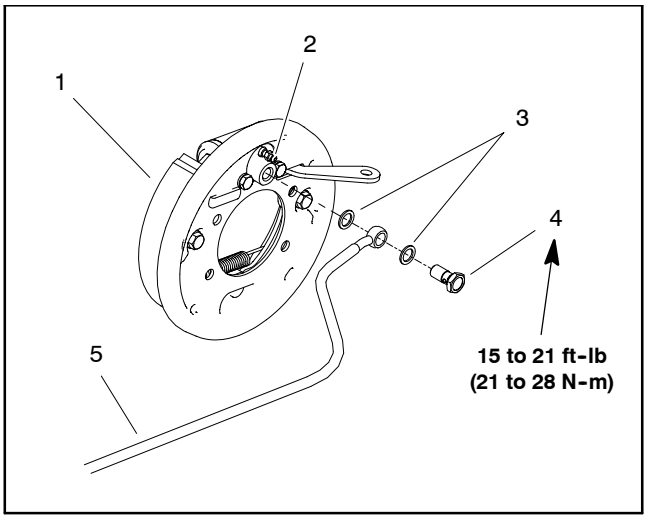


Figure 19

1. **Brake assembly**
2. **Wheel cylinder**
3. **Banjo washer**
4. **Banjo bolt**
5. **Brake line**

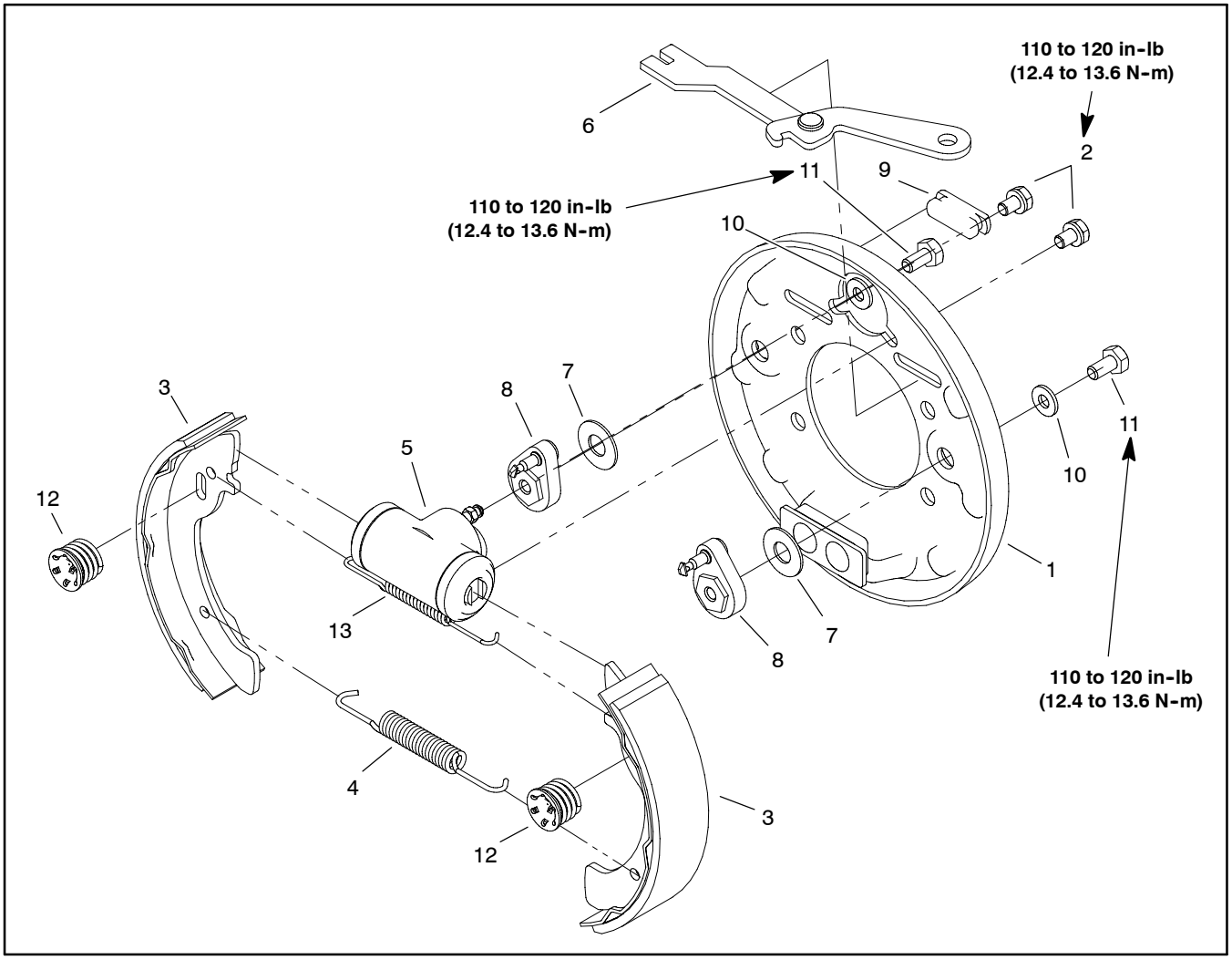


Figure 20

1. Brake backing plate
2. Washer head screw
3. Brake shoe
4. Lower spring
5. Wheel cylinder
6. Parking brake lever (LH shown)
7. Belleville washer
8. Adjuster lever
9. Dust cover
10. Flat washer
11. Bolt
12. Shoe hold down cup and spring
13. Upper spring

**Disassembly (Fig. 20)**

**CAUTION**

**Be careful when removing springs from brake shoes. The springs are under heavy load and may cause personal injury.**

1. Remove upper and lower springs from brake shoes.

2. Remove shoe hold down cups and springs that secure the brake shoes to the backing plate.

3. Remove brake shoes from backing plate.

4. If required, slide parking brake lever from slot and dust cover in backing plate.

5. If necessary, remove two (2) washer head screws that secure wheel cylinder to backing plate. Remove wheel cylinder from backing plate.

6. If necessary, remove bolts and washers to allow adjuster levers to be separated from backing plate. Locate and remove belleville washers from between adjuster levers and backing plate.

**Inspection (Fig. 20)**

1. Inspect brake drums.

**IMPORTANT: Brake drum machining is not recommended. Replace brake drums as a set to maintain equal braking forces.**

A. Clean drums with denatured alcohol. Check braking surface diameter in at least three places. If the diameter exceeds 6.320 inches (160.5 mm), replace both brake drums.

B. Replace drums that are cracked, deeply grooved, tapered, significantly out-of-round, scored, heat spotted or excessively rusted.

C. Minor scoring can be removed with sandpaper.

2. Inspect brake shoe linings.

**IMPORTANT: Replace brake shoes as a set (all four shoes) to maintain equal braking forces.**

A. Replace brake shoes if damaged or if lining is worn to 1/16" (1.6 mm). Replace if lining is contaminated by oil, grease or other fluids.

**NOTE:** Overheated springs lose their tension, and can cause brake linings to wear out prematurely.

B. Inspect brake shoe webbing, upper and lower springs and shoe hold down springs for overheating. Overheating is indicated by a slight blue color. Inspect brake shoe webbing for deformation. Replace parts as necessary.

C. Inspect hold down pins on adjuster levers for bends, rust and corrosion. Replace as necessary.

3. Inspect backing plate surfaces, which contact with the brake shoes for grooves that may restrict shoe movement. Replace plate if grooves can not be removed by light sanding with emery cloth or other suitable abrasive. Replace plate if cracked, warped or excessively rusted.

4. Inspect adjuster levers for deformation. Replace levers if deformation or excessive rust is found.

5. Replace parking brake cables if frayed, stretched or kinked.

**Assembly (Fig. 20)**

**IMPORTANT: Brake shoe lining surfaces must be free of grease, oil and other foreign matter.**

1. Apply a light film of lubricant to the following:

A. Ledges on which the brake shoes rest.

B. Pin surfaces on adjuster levers.

C. Anchor block surface that contacts shoe webs.

D. Both surfaces of belleville washers that are positioned between adjuster levers and backing plate.

2. If removed, position lubricated belleville washer between lever adjuster and backing plate. Secure adjuster to backing plate with washer and bolt. Torque bolt from **110 to 120 in-lb (12.4 to 13.6 N-m)**.

3. If removed, secure wheel cylinder to backing plate with two (2) washer head screws. Torque screws from **110 to 120 in-lb (12.4 to 13.6 N-m)**.

4. If removed from backing plate, slide parking brake lever into slot and dust cover in backing plate.

5. Position brake shoes to backing plate. Make sure that each shoe is properly positioned at anchor block, parking brake lever, wheel cylinder and pin on adjuster lever. Secure shoes to backing plate with shoe hold down cups and springs.

**CAUTION**

**Be careful when installing springs to brake shoes. The springs are under heavy load and may cause personal injury.**

6. Secure brake shoes with upper and lower springs.

## Front Brake Calipers

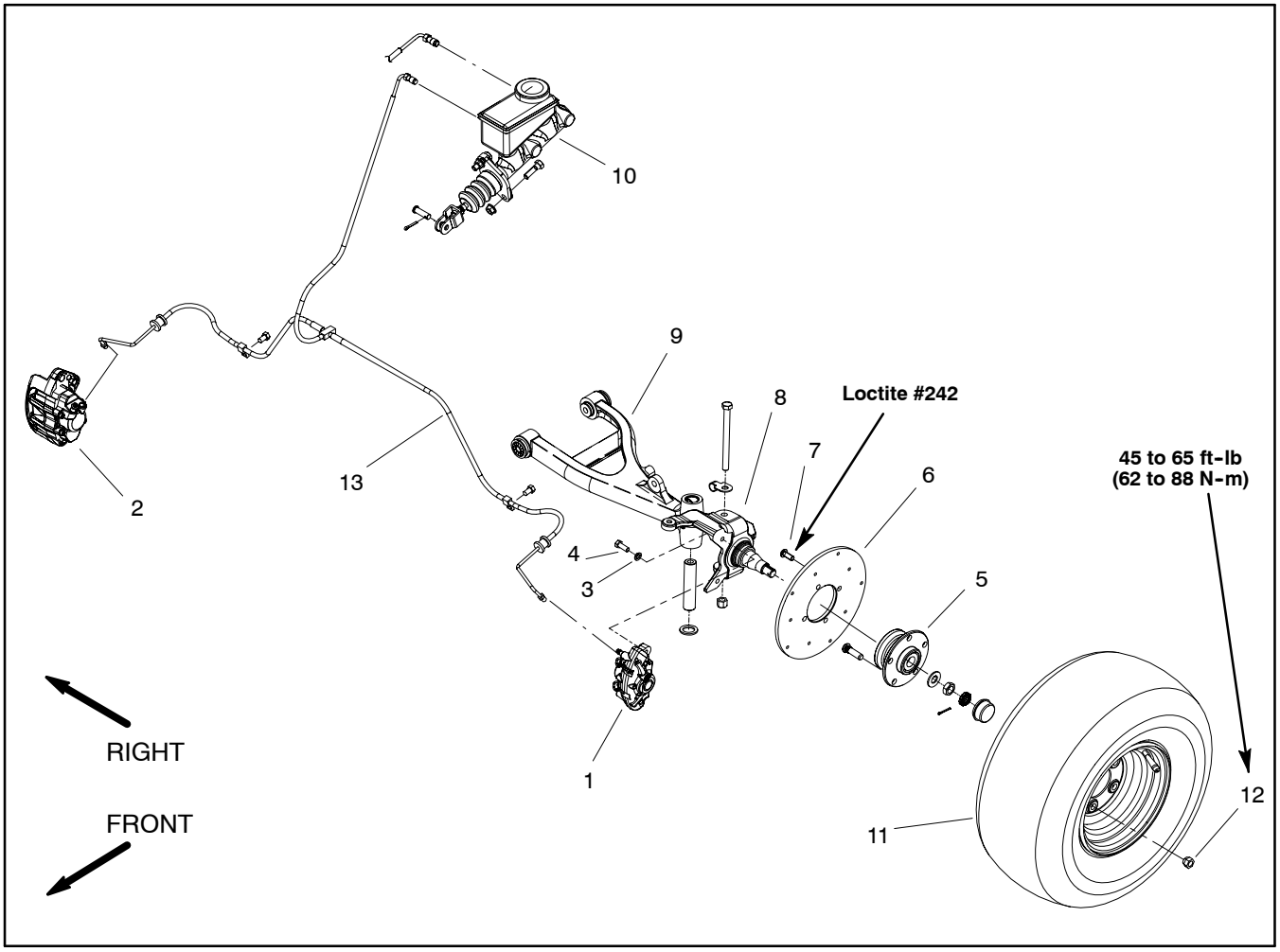


Figure 21

1. **LH brake caliper**
2. **RH brake caliper**
3. **Lock washer (2 per caliper used)**
4. **Cap screw (2 per caliper used)**
5. **Wheel hub assembly**
6. **Brake rotor**
7. **Socket head screw (4 per rotor used)**
8. **Spindle (LH shown)**
9. **A-arm (LH shown)**
10. **Brake master cylinder**
11. **Wheel assembly**
12. **Lug nut (5 used per wheel)**
13. **Front brake hose**

**Disassembly (Fig. 21)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

**WARNING**

**Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.**

2. Chock wheels not being jacked up. Jack front wheel off the ground and place appropriate jack stand beneath the frame to support vehicle.

3. Remove front wheel from machine (see Lower Steering and Front Wheel Removal).

4. Clean hydraulic brake line area of brake caliper to prevent contamination. Loosen and disconnect brake line from caliper. Plug brake line and position it away from caliper.

5. Remove two (2) cap screws and lock washers that secure the brake caliper to the spindle.

6. Slide brake caliper from brake rotor and remove caliper from machine.

**Assembly (Fig. 21)**

1. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

2. Align caliper mounting holes with spindle. Secure caliper with two (2) cap screws and lock washers.

3. Install brake hose to caliper.

4. Install front wheel assembly.

5. Lower machine to ground.

6. Torque lug nuts in a crossing pattern from **45 to 65 ft-lb (62 to 88 N-m)**.

7. Bleed brakes (see Bleed Brake System in this section).

**CAUTION**

**After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

8. Check brake operation.

## Front Brake Caliper Service

**Disassembly (Fig. 22)**

1. If caliper is equipped with anti−rattle clip, remove clip from caliper, pins and brake pads.

2. Remove pins from caliper by prying with a flat blade screwdriver through loop in pins.

3. Slide brake pads from caliper. For assembly purposes, note orientation of inner and outer pads as the pads are not the same.

4. Replace the brake pads if the friction material is worn to less than 1/32” (0.8 mm).

**Assembly (Fig. 22)**

1. If brake pads are being replaced, it will be necessary to push caliper pistons back into the caliper bore before installing new pads.

2. Slide brake pads into caliper. Make sure that lining material on pads is toward brake rotor position.

3. Secure pads into caliper with two (2) pins. Make sure that pins snap into caliper slots.

4. If caliper is equipped with anti−rattle clip, install clip to caliper, pins and brake pads.

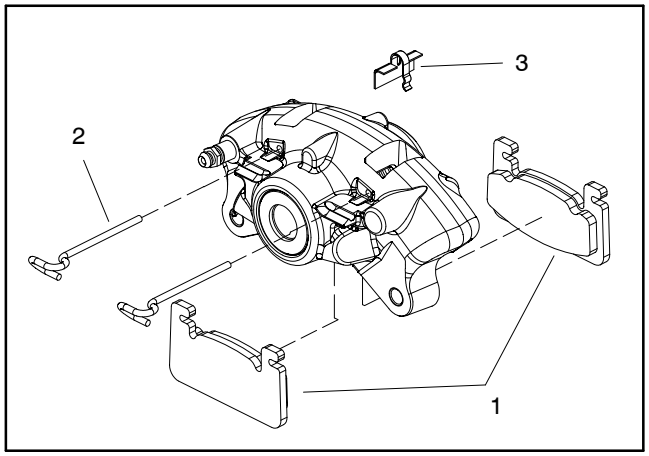


Figure 22

1. **Brake pad**
2. **Pin (2 used)**
3. **Clip (if equipped)**

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## Brake Master Cylinder

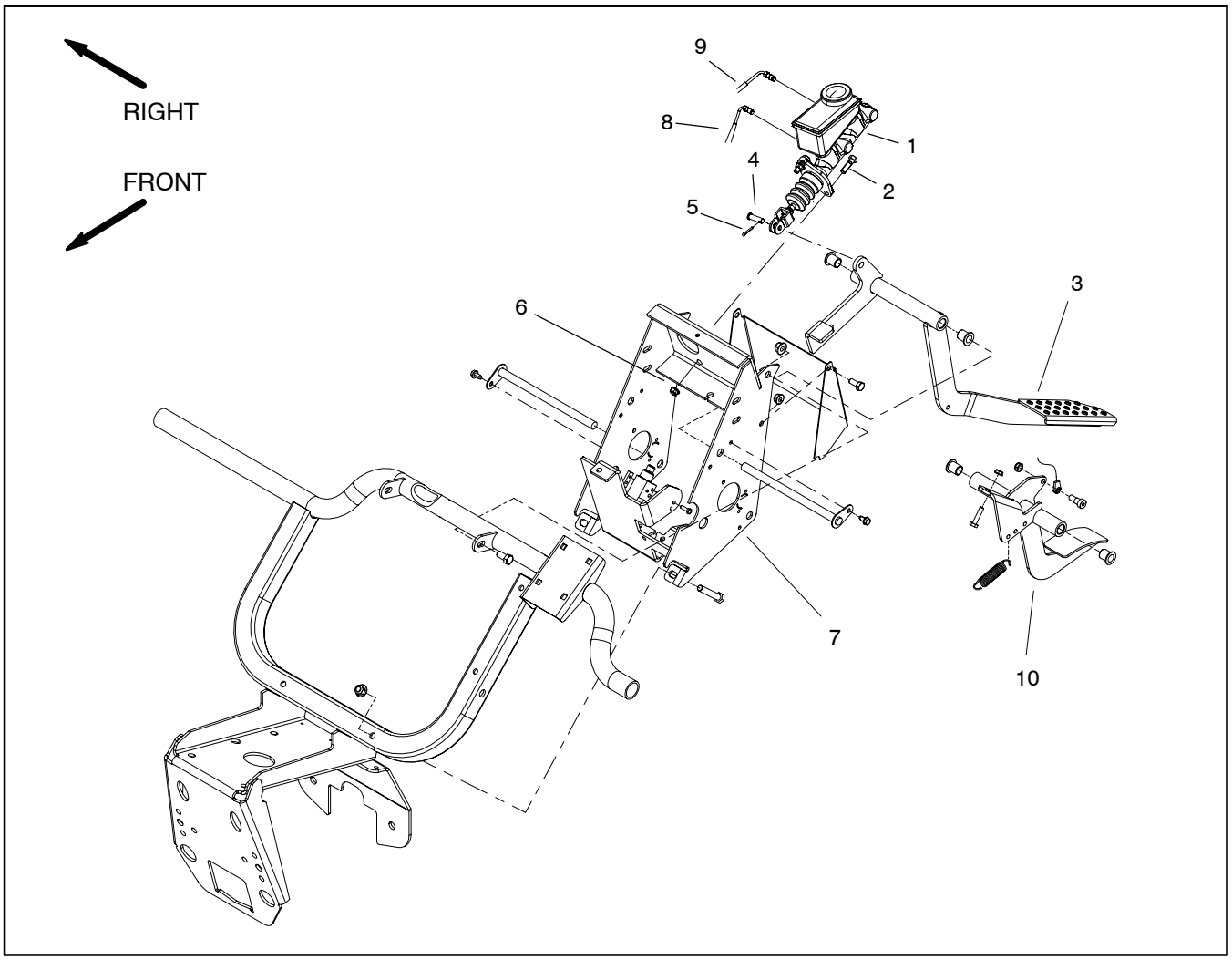


Figure 23

1. **Master cylinder**
2. **Cap screw**
3. **Brake pedal**
4. **Clevis pin**
5. **Cotter pin**
6. **Flange head nut**
7. **Pedal frame**
8. **Front brake line**
9. **Rear brake line**
10. **Accelerator pedal**

**Removal (Fig. 23)**

1. Raise front hood to gain access to master cylinder.

2. Remove cotter pin from the clevis pin that connects master cylinder to brake pedal.

**IMPORTANT: To prevent contamination of the brake system, make sure to clean components before disassembly.**

3. Clean hydraulic brake line area of master cylinder to prevent contamination. Remove both brake lines from master cylinder. Cap ends of brake lines and position them away from master cylinder.

4. Remove two (2) flange head nuts and cap screws that secure master cylinder to pedal frame.

5. Pull master cylinder from machine.

**Installation (Fig. 23)**

1. Position master cylinder to pedal frame and secure with cap screws and flange nuts.

2. Remove plugs from brake lines. Install brake lines to master cylinder.

3. Connect master cylinder to brake pedal with clevis pin and cotter pin.

4. Install front hood to machine (see Front Hood Installation in this section).

5. Bleed brakes (see Bleed Brake System in this section).

**CAUTION**

**After servicing brake system components, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

6. Check brake operation.

## Brake Master Cylinder Service

### Disassembly (Fig. 24)

1. Thoroughly clean outside of master cylinder before disassembly.

2. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.

3. Disconnect lower end of the dust cover from the housing.

4. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.

5. Remove primary piston assembly and secondary piston assembly from cylinder housing.

### Inspection

**CAUTION**

**Use eye protection such as goggles when using compressed air for master cylinder service.**

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.

2. Check cylinder bore, pistons and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring or cracks are evident in cylinder bore.

### Assembly (Fig. 24)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.

2. Install secondary piston assembly and primary piston assembly into cylinder.

3. Install retainer washer.

4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.

5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

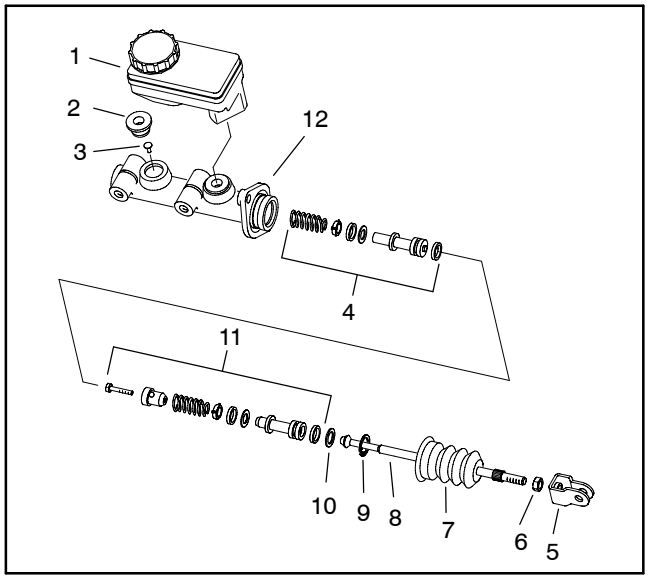


Figure 24

1. **Reservoir**
2. **Flange seal**
3. **Stop pin**
4. **Secondary piston assy**
5. **Clevis**
6. **Jam nut**
7. **Dust cover**
8. **Push rod**
9. **Circlip**
10. **Retainer washer**
11. **Primary piston assy**
12. **Cylinder housing**

## Bleed Brake System

**IMPORTANT: To prevent contamination of the brake system, make sure to clean components before disassembly.**

1. Connect a suitable transparent hose to bleeder valve on rear wheel brake cylinder or front brake caliper. Submerge other end of hose in a glass container partially filled with clean brake fluid.

2. Have a helper pump brake pedal several times, then hold pedal down firmly.

3. With pedal firmly depressed, open bleeder valve of brake until pedal fades to floor. Close bleeder valve before releasing pedal.

4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve. **Make sure fluid level is maintained in brake fluid reservoir at all times**.

5. Repeat steps 1 to 4 for other rear brake cylinders and front calipers.

**CAUTION**

**After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.**

6. After bleeding of brakes is completed, test vehicle to make sure brakes are operating correctly and pedal is solid.

## Seat Base

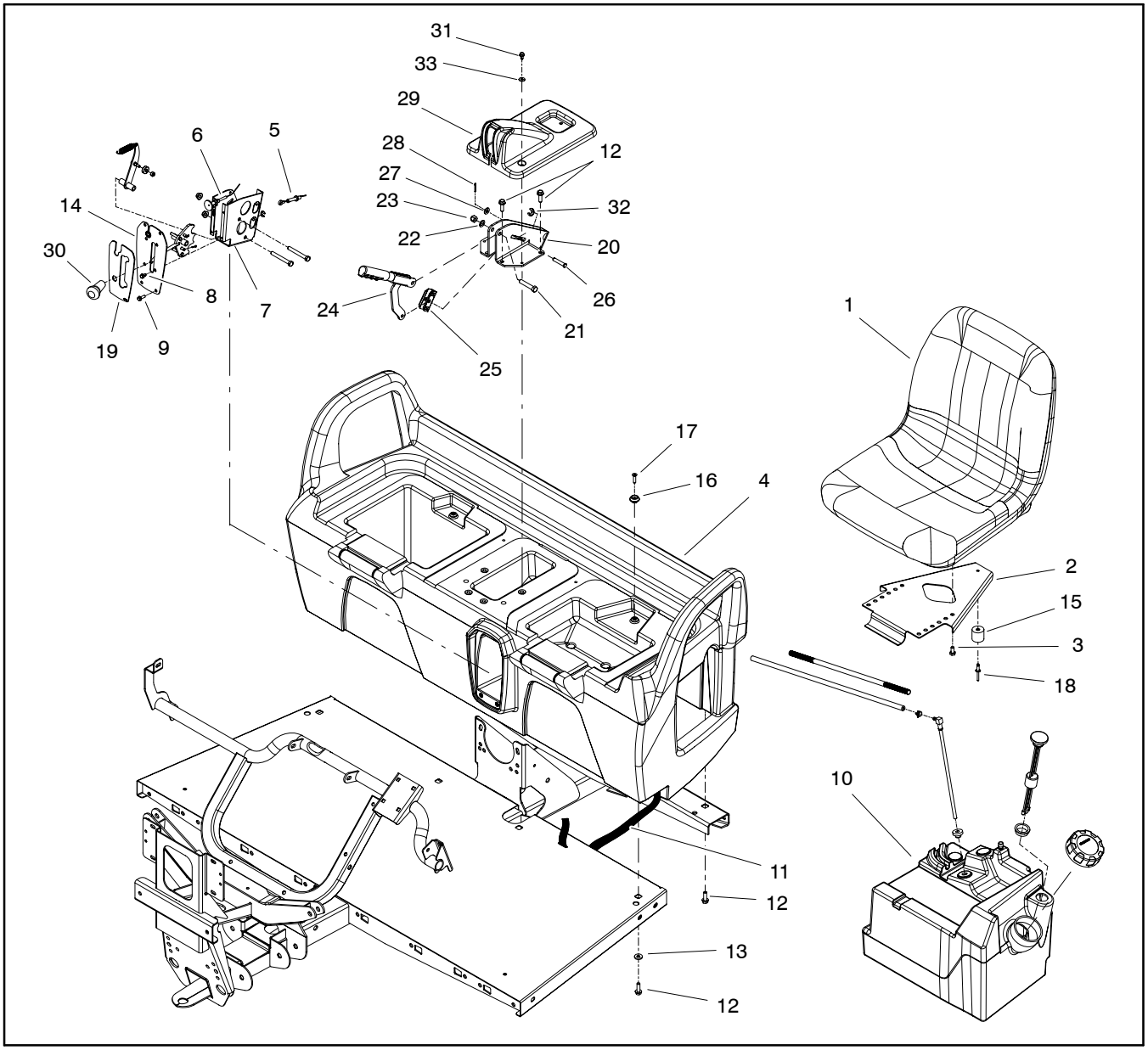


Figure 25

1. Seat (2 used)
2. Seat bracket (2 used)
3. Cap screw (8 used)
4. Seat base
5. Shift cable (2 used)
6. Choke cable
7. Shift bracket
8. Short screw (4 used)
9. Long screw (4 used)
10. Fuel tank
11. Web strapping
12. Flange head screw (12 used)
13. Flat washer (4 used)
14. Shifter plate
15. Rubber receptacle (2 used)
16. Holding post (2 used)
17. Screw (2 used)
18. Rivet (2 used)
19. Decal
20. Parking brake support
21. Cap screw
22. Curved washer
23. Lock nut
24. Parking brake lever
25. Equalizer bracket
26. Clevis pin
27. Flat washer
28. Cotter pin
29. Parking brake cover
30. Knob
31. Screw (2 used)
32. Retaining ring (2 used)
33. Flat washer (2 used)

**Seat Base Removal (Fig. 25)**

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.

2. Flip both seats forward and remove them from the seat base.

3. Remove parking brake assembly from seat base (see Parking Brake Disassembly in this section).

4. Unscrew knob from the shift lever. Remove four (4) short cap screws securing the shift plate to the shift bracket (Fig. 26).

5. Remove four (4) long cap screws securing the shift plate to the seat base (Fig. 26). Separate shift bracket from the choke cable and seat base.

6. Remove eight (8) flange head screws and flat washers that secure the seat base to the frame.

**IMPORTANT: Make sure shift bracket, shift cables, choke cable and fuel tank do not catch on the seat base during removal.**

7. Lift seat base carefully from the machine.

**Seat Base Installation (Fig. 25)**

**IMPORTANT: Make sure shift bracket, shift cables, choke cable and fuel tank do not catch on the seat base during installation.**

1. Position seat base carefully to the frame.

**NOTE:** Do not tighten fasteners securing the seat base to the frame until all of them are installed.

2. Install eight (8) flange head screws and flat washers through the frame and into the seat base. Tighten screws from the middle of the vehicle to the outside.

3. Place shift bracket, shift cables and choke cable through the opening at the front of the seat base.

4. Position choke cable and shift plate to shift bracket making sure to capture cable flange. Secure shift plate to shift bracket with four (4) short cap screws. Screw knob onto the shift lever (Fig. 26).

5. Position shift plate with shift bracket to the seat base. Secure shift plate to seat base with four (4) long cap screws (Fig. 26).

6. Install parking brake assembly to seat base (see Parking Brake Assembly in this section).

7. Secure seats to seat base.

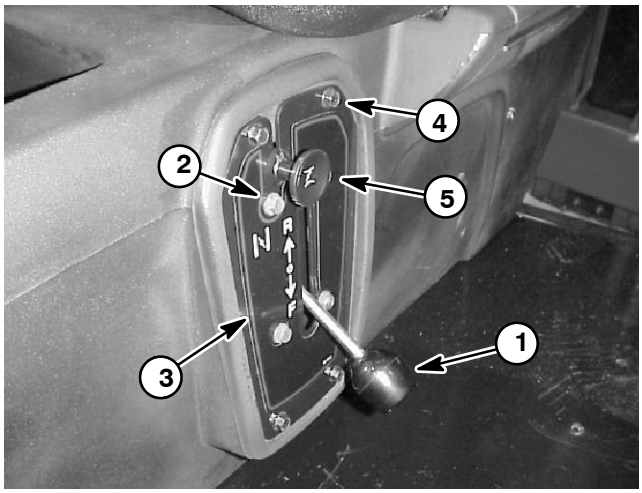


Figure 26

1. **Shift lever**
2. **Cap screw (short)**
3. **Shift plate**
4. **Cap screw (long)**
5. **Choke cable**

## Front Hood

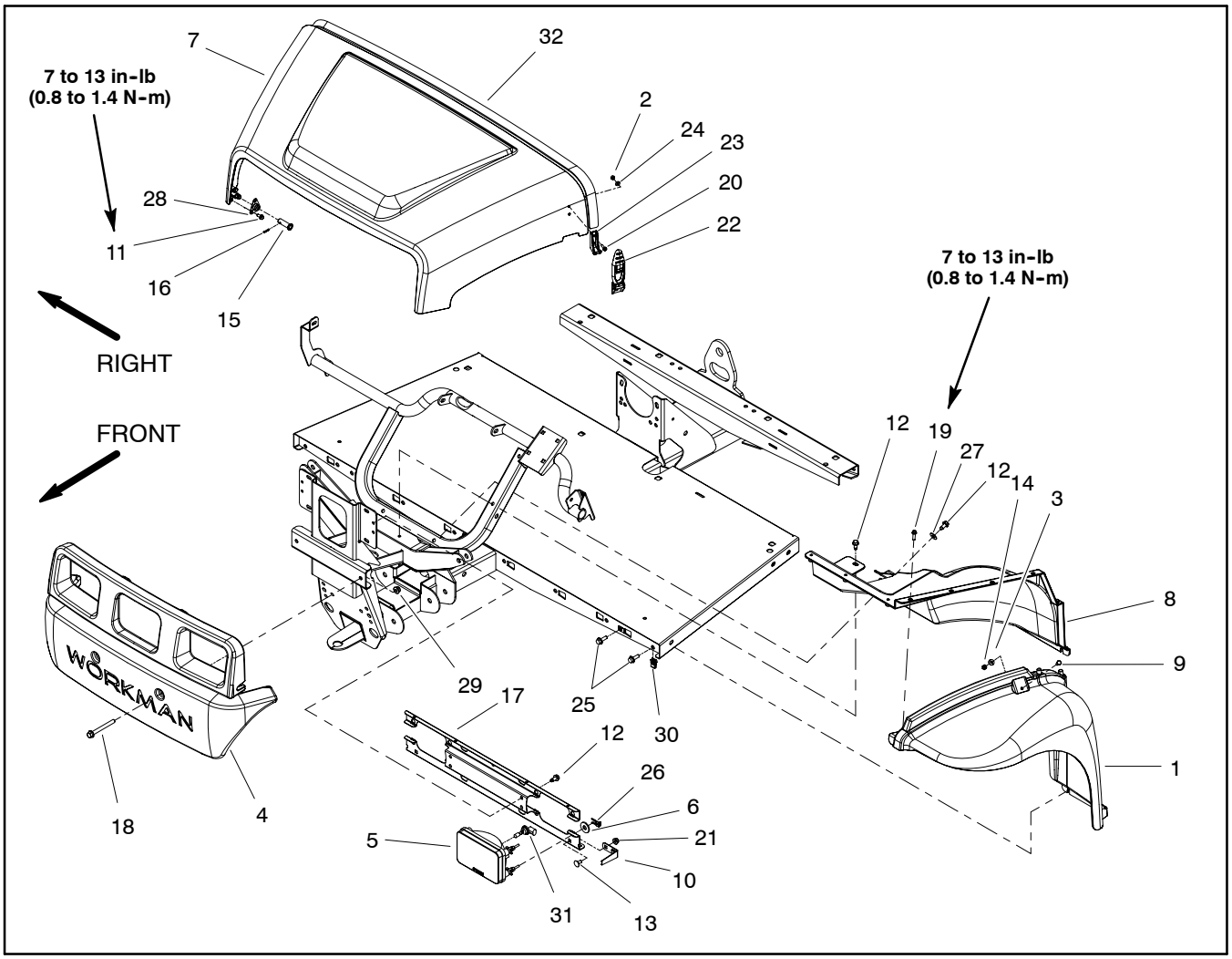


Figure 27

1. Fender (LH shown)
2. Lock nut (4 used)
3. Flat washer (2 used)
4. Front bumper
5. Headlight (2 used)
6. Washer (3 used per headlight)
7. Hood
8. Fender well (LH shown)
9. Cap screw (2 used)
10. Hood pivot keeper (2 used)
11. Screw (6 used)
12. Washer head screw (8 used)
13. Carriage screw (2 used)
14. Lock nut (2 used)
15. Pivot pin (2 used)
16. Spring pin (2 used)
17. Headlight bracket
18. Flange head screw (2 used)
19. Washer head screw (20 used)
20. Washer head screw (4 used)
21. Flange nut (2 used)
22. Rubber latch (2 used)
23. Catch (2 used)
24. Flat washer (4 used)
25. Flange head screw (10 used)
26. Clip (3 used per headlight)
27. Flat washer (2 used)
28. Retainer (2 used)
29. Flange nut (2 used)
30. Tinnerman nut (10 used)
31. Headlight bulb (2 used)
32. Foam seal

**Removal (Fig. 27)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition.

2. Remove hood using Figure 27 as a guide.

**Installation (Fig. 27)**

**NOTE:** Do not tighten fasteners securing the hood until all fasteners are in place.

1. Install hood using Figure 27 as a guide. During assembly, use fastener torque specifications that are identified in Figure 28.

## Cargo Box (Serial Numbers Below 311000000)

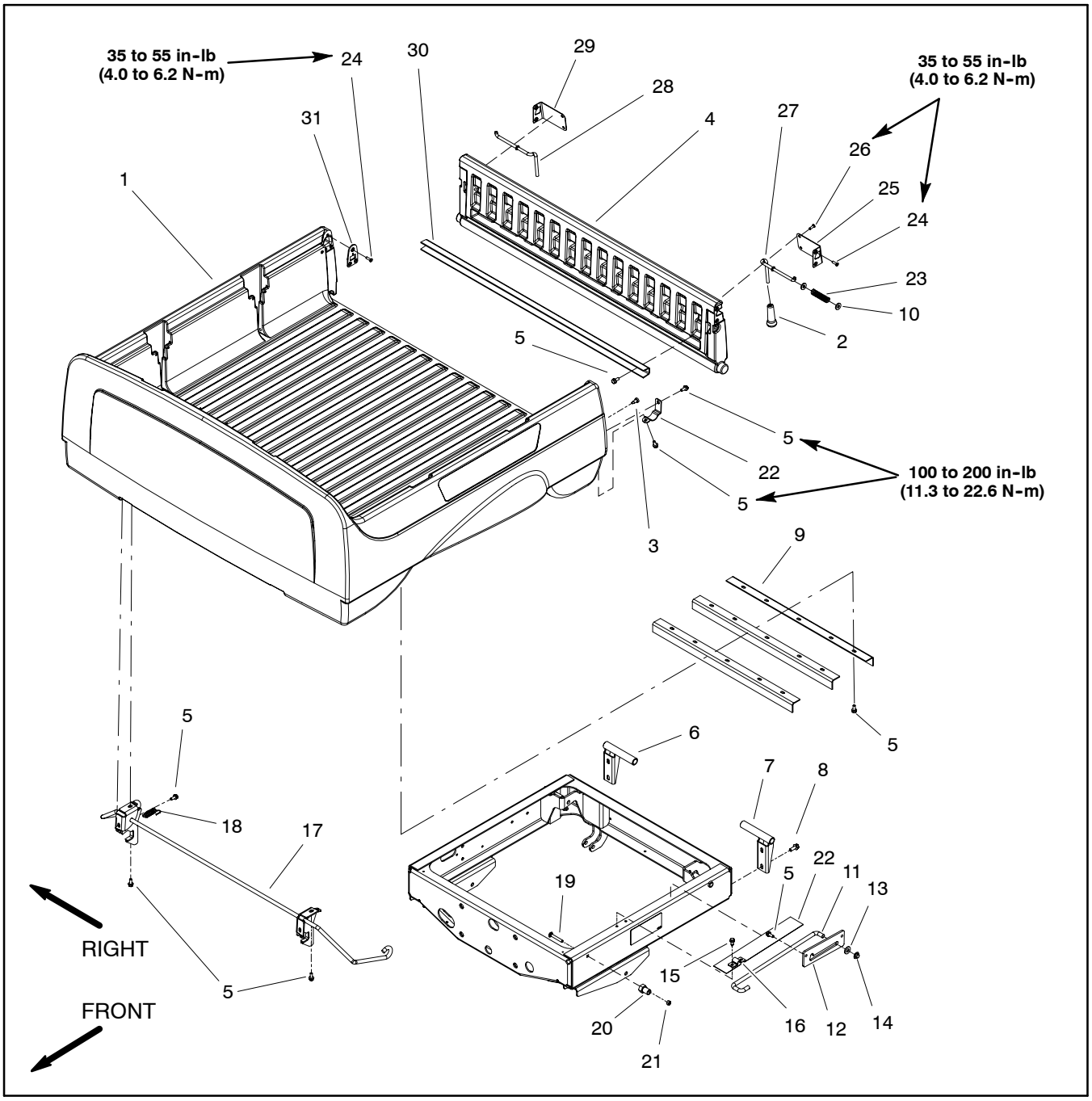


Figure 33

1. Cargo box
2. Knob (2 used)
3. Rubber bumper (2 used)
4. Tailgate
5. Flange head screw (31 used)
6. RH pivot bracket
7. LH pivot bracket
8. Flange head screw (4 used)
9. Box brace (3 used)
10. Latch washer (4 used)
11. Prop rod
12. Prop rod bracket
13. Flat washer
14. Push nut
15. Washer head screw (2 used)
16. Prop rod bracket
17. Latch rod
18. Tension spring (2 used)
19. Carriage screw (2 used)
20. Latch pin (2 used)
21. Lock nut (2 used)
22. Pivot bracket (2 used)
23. Spring (2 used)
24. Screw (10 used)
25. LH tailgate bracket
26. Screw
27. LH latch rod
28. RH latch rod
29. RH tailgate bracket
30. Tailgate channel
31. Striker plate (2 used)

**Removal (Fig. 33)**

**NOTE:** If cargo box has been replaced with newer box design, refer to Cargo Box (Serial Numbers Above 311000000) in this section.

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Disassemble cargo box as necessary using Figure 33 as a guide.

**Installation (Fig. 33)**

1. Assemble cargo box using Figure 33 as a guide.

   A. When installing tailgate and tailgate hardware, use torque specifications identified in Figure 33.

   B. Adjust latch pin (item 20) so that cargo box is tight to frame when latched.

## Cargo Box (Serial Numbers Above 311000000)

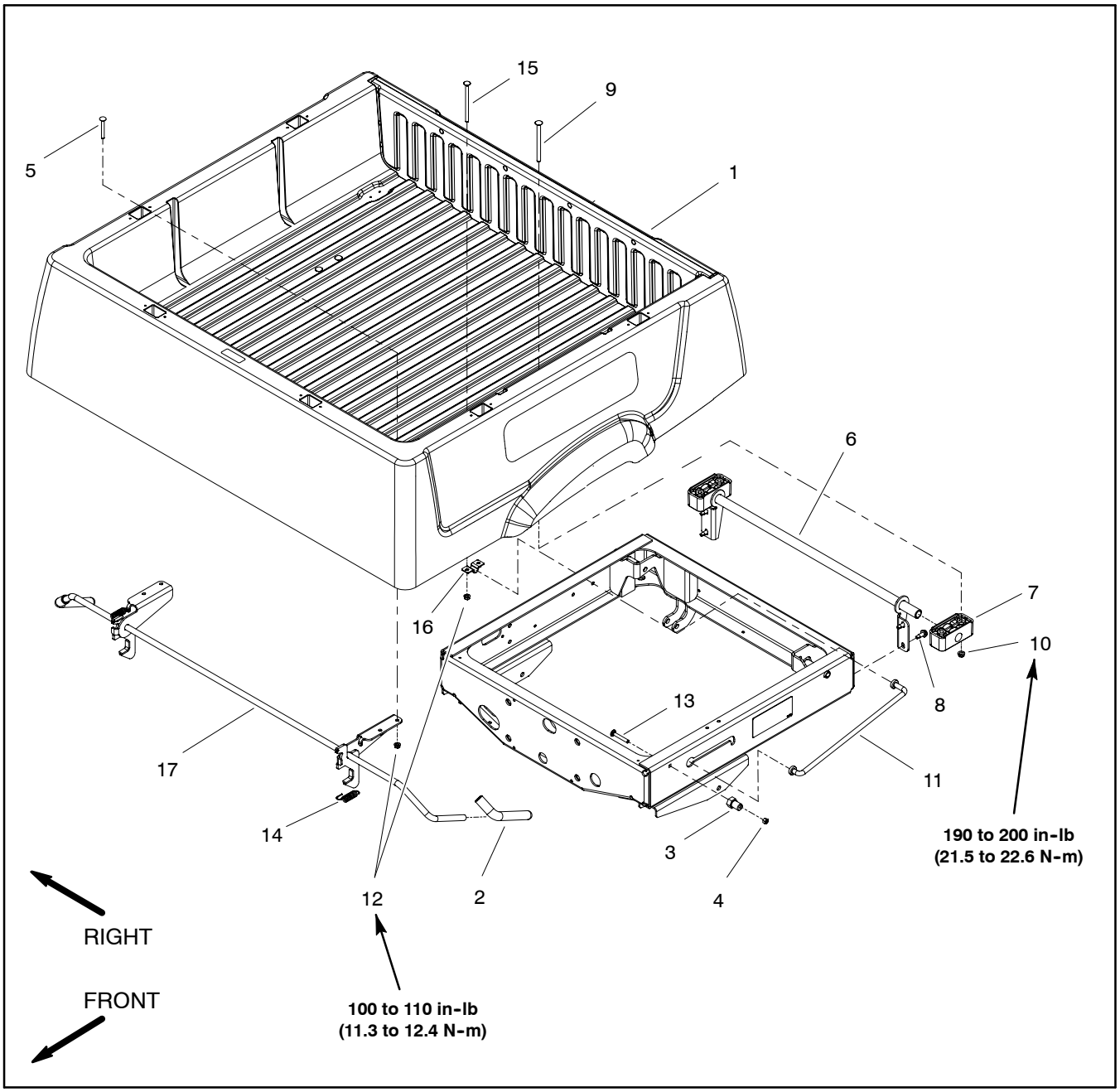


Figure 34

1. Cargo box
2. Handle
3. Latch pin (2 used)
4. Lock nut (2 used)
5. Carriage screw (4 used)
6. Pivot bracket
7. Pivot bushing (2 used)
8. Screw (4 used)
9. Carriage screw (4 used)
10. Flange nut (4 used)
11. Prop rod
12. Flange nut (6 used)
13. Carriage screw (2 used)
14. Tension spring (2 used)
15. Carriage screw (2 used)
16. Prop rod bracket
17. Latch assembly

**Removal (Fig. 34)**

1. Park machine on a level surface, stop engine, set parking brake and remove key from the ignition switch.

2. Disassemble cargo box as necessary using Figures 34 and 35 as guides.

**Installation (Fig. 34)**

1. Assemble cargo box using Figures 34 and 35 as guides.

   A. When installing cargo box, use torque specifications identified in Figure 34.

   B. Adjust latch pin (item 3 in Figure 34) so that cargo box is tight to frame when latched.

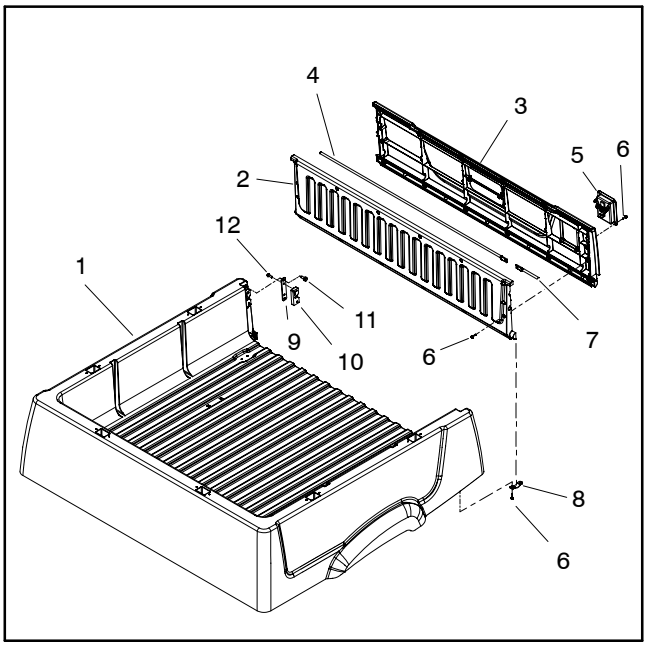


Figure 35

1. **Cargo box**
2. **Inner tailgate**
3. **Outer tailgate**
4. **RH latch rod**
5. **Latch handle**
6. **Screw (24 used)**
7. **LH latch rod**
8. **Retainer (2 used)**
9. **Striker mount (2 used)**
10. **Strike latch (2 used)**
11. **Screw (4 used)**
12. **Screw (4 used)**

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Chapter 8

# Electrical Drawings

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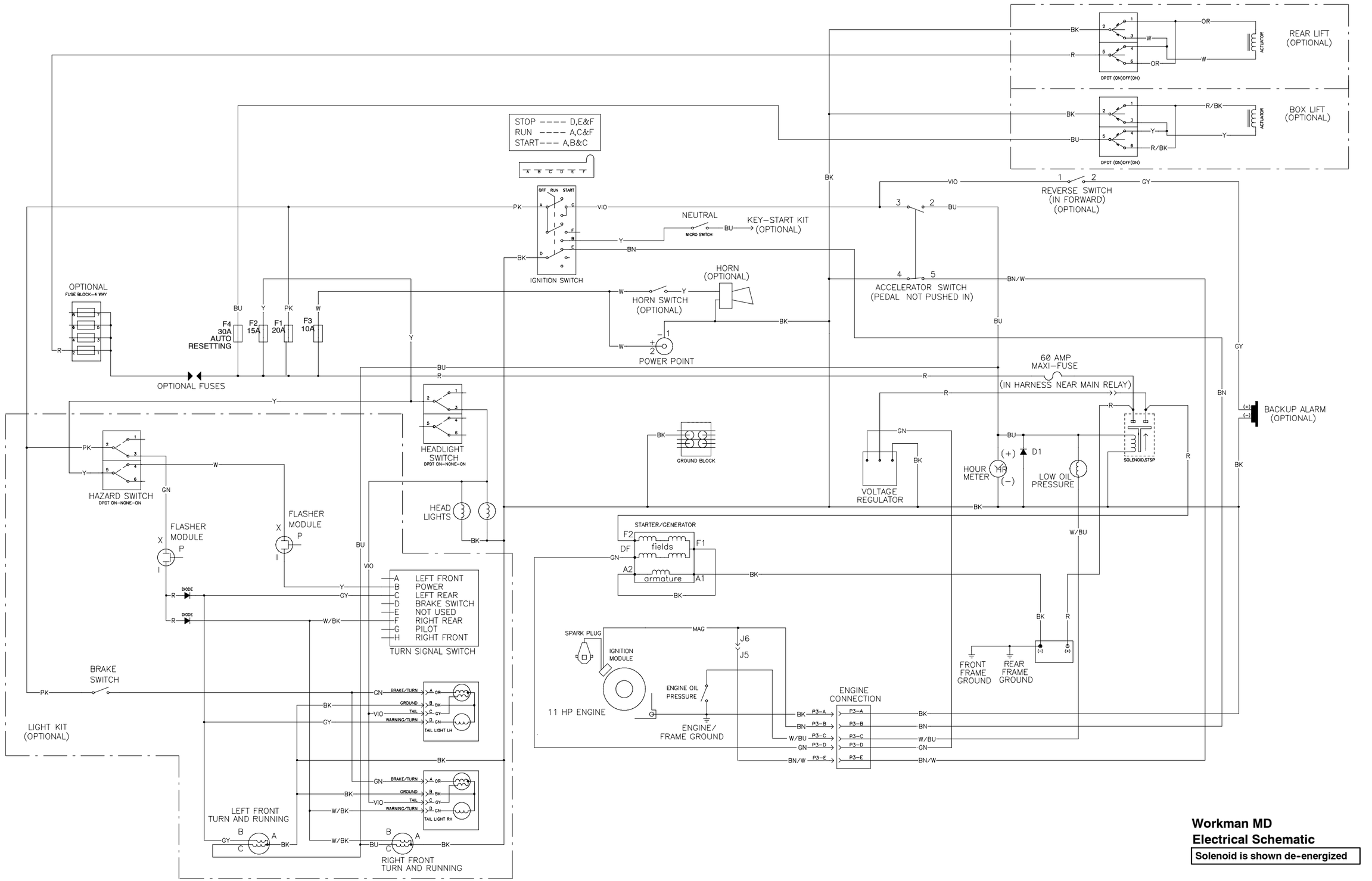
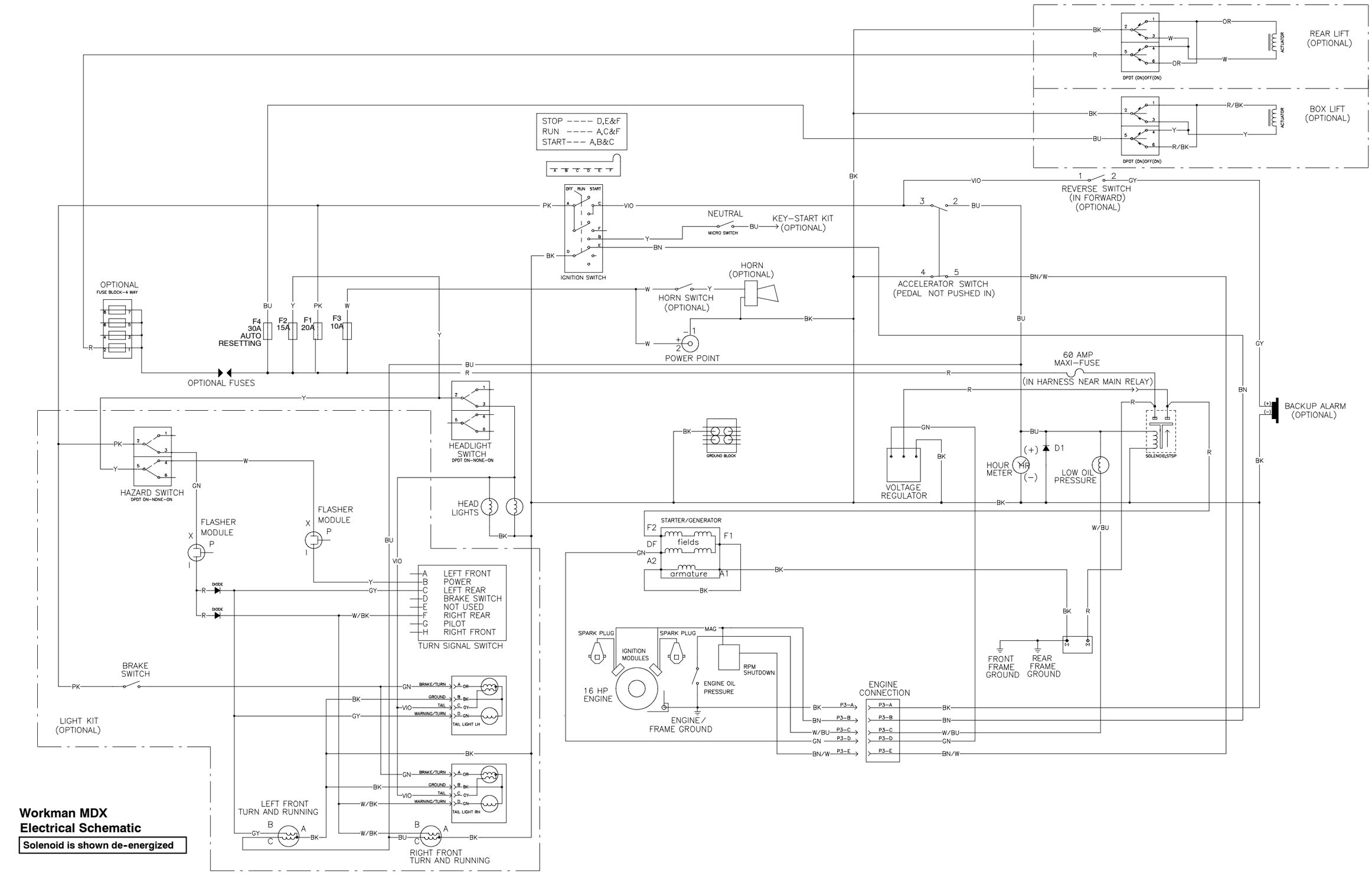


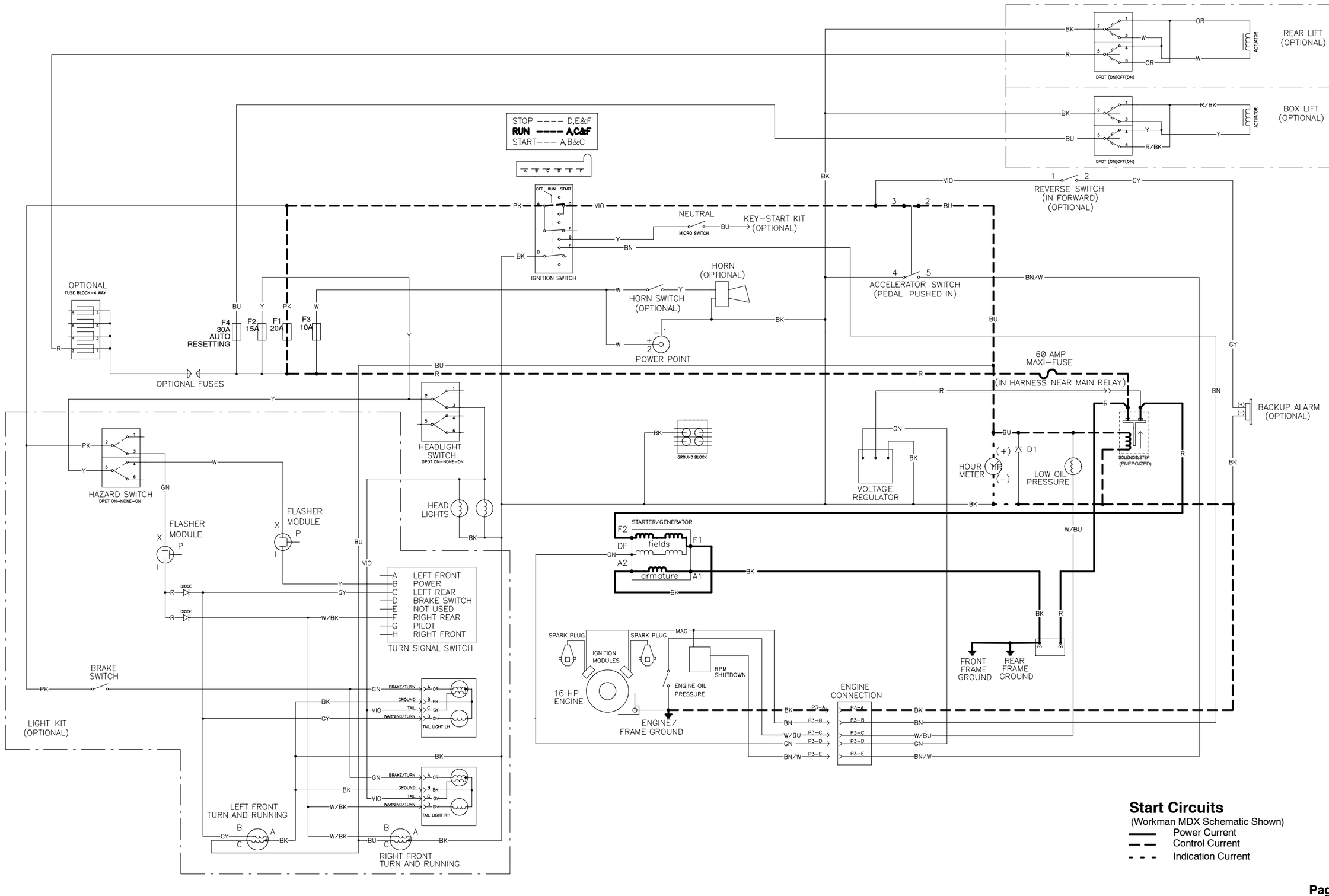

**Workman MD**
**Electrical Schematic**

**Solenoid is shown de-energized**




**Workman MDX**
**Electrical Schematic**

**Solenoid is shown de-energized**



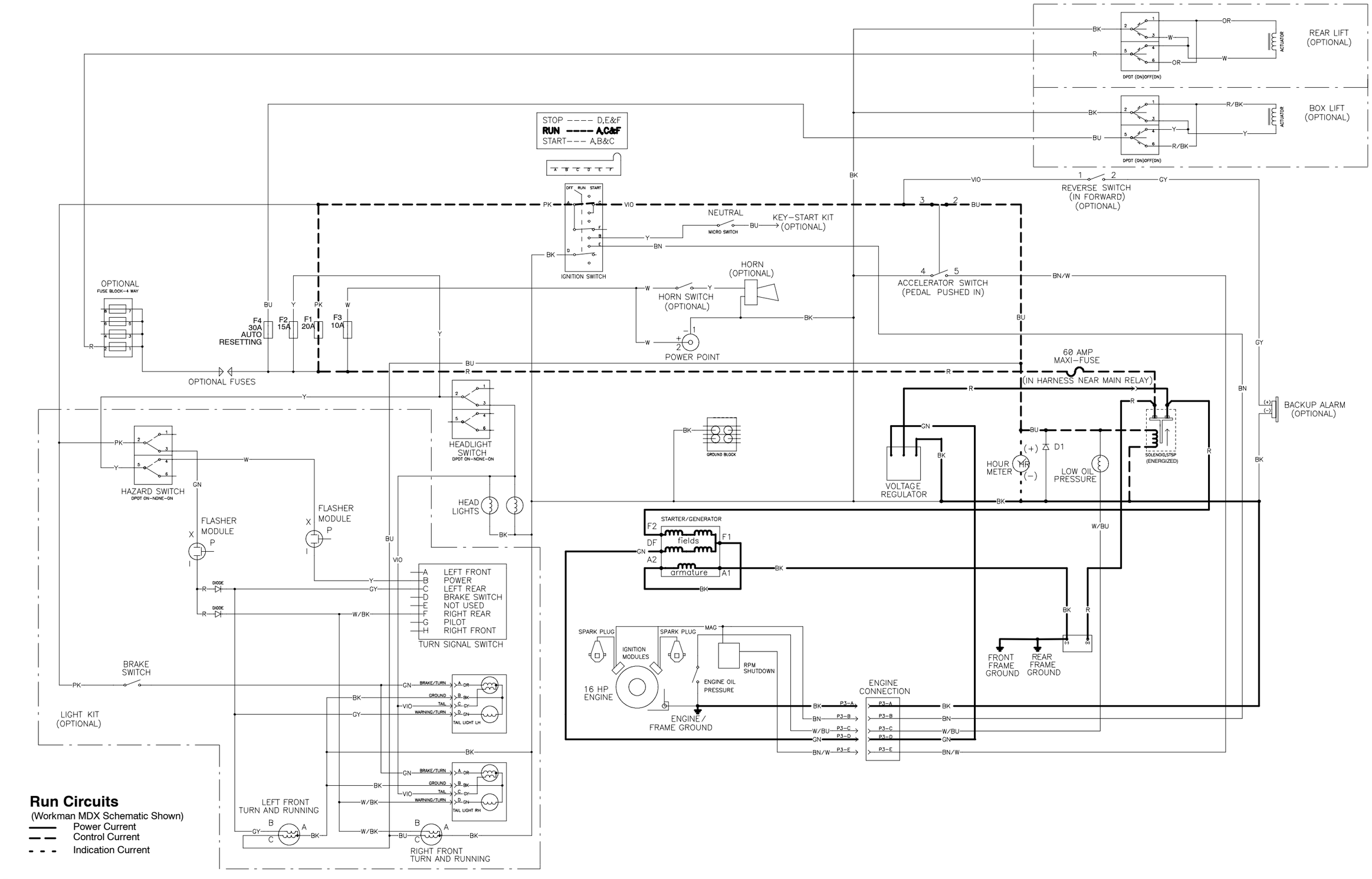

## Start Circuits

(Workman MDX Schematic Shown)

Power Current

Control Current

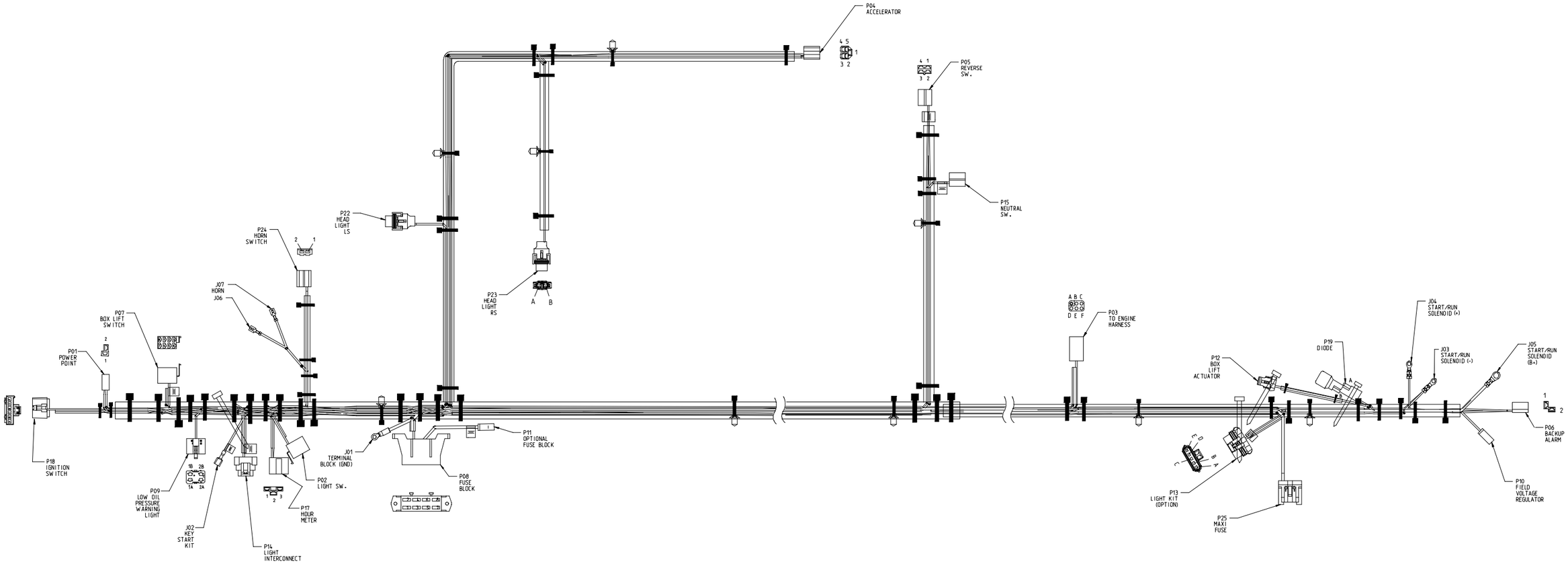
Indication Current



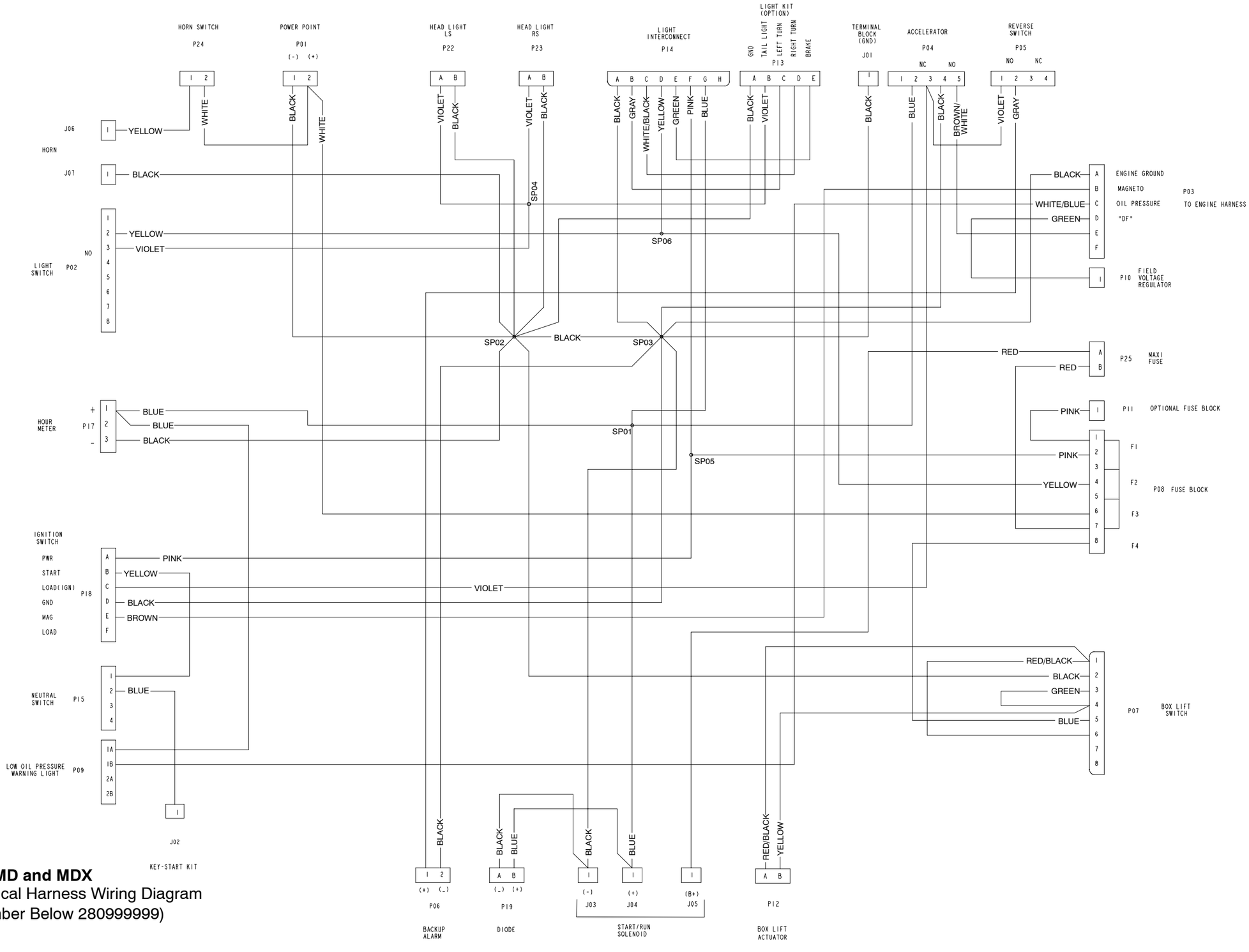

## Run Circuits

(Workman MDX Schematic Shown)

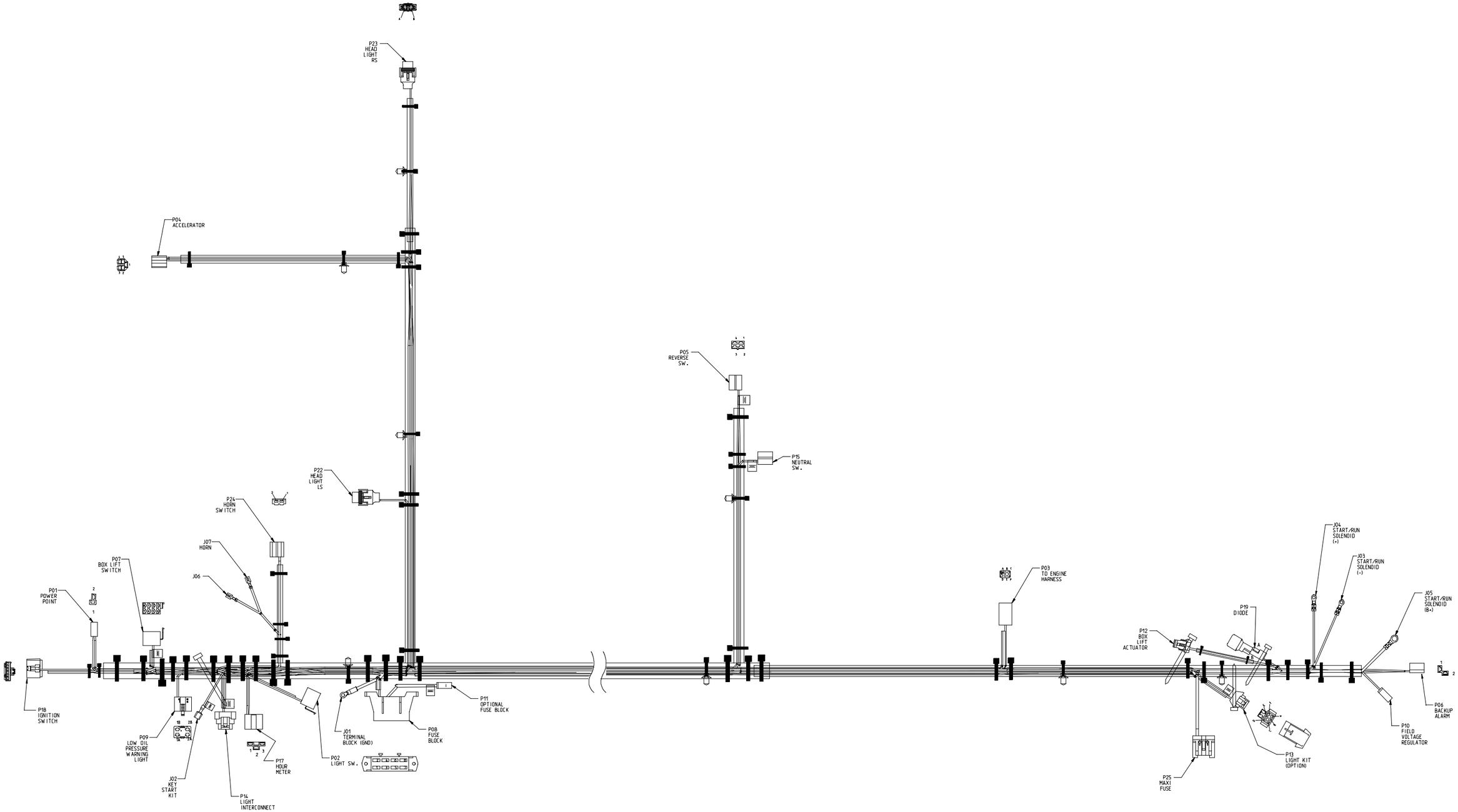
- Power Current
- Control Current
- Indication Current



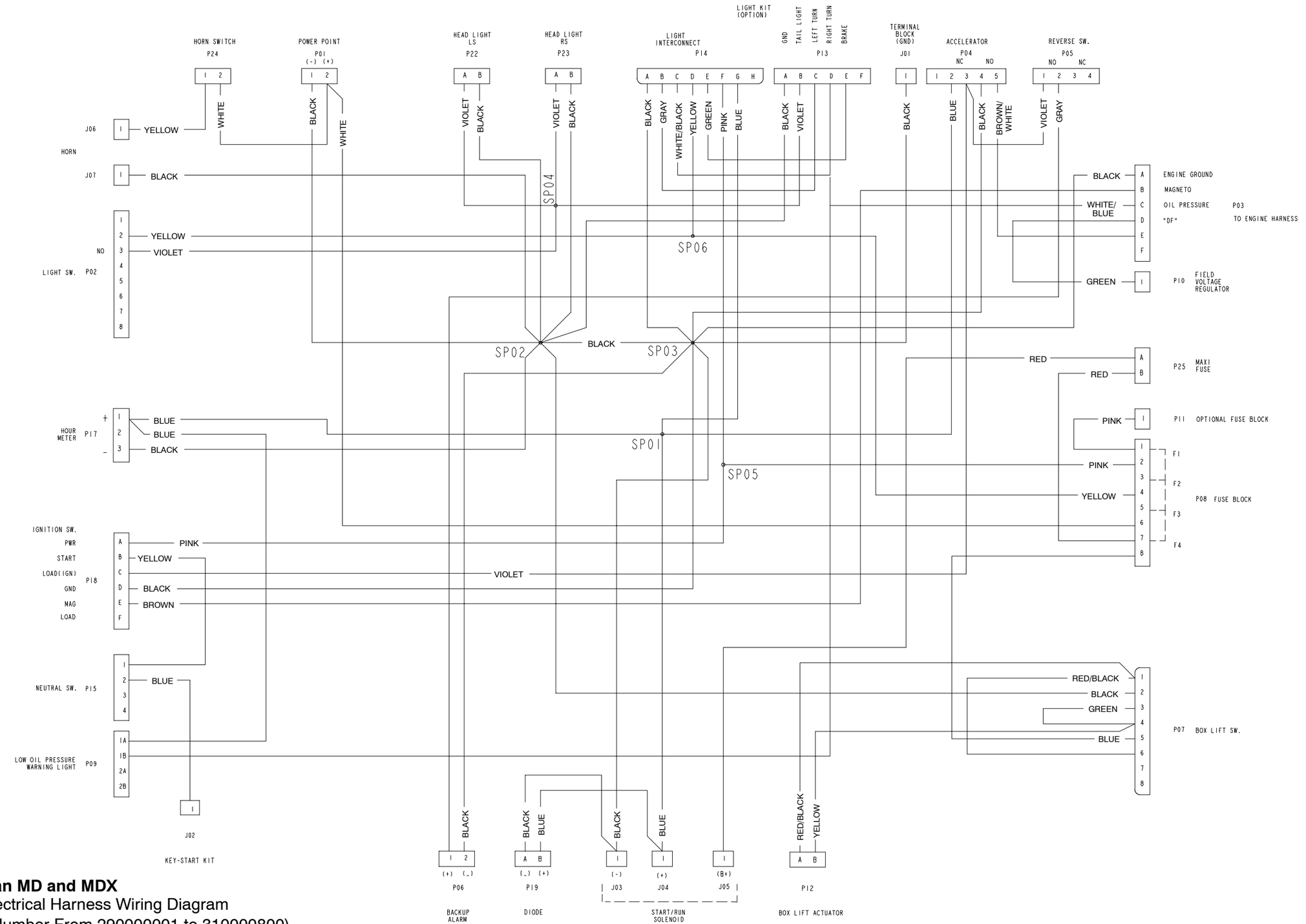

**Workman MD and MDX**
Main Electrical Harness Drawing
(Serial Number Below 280999999)



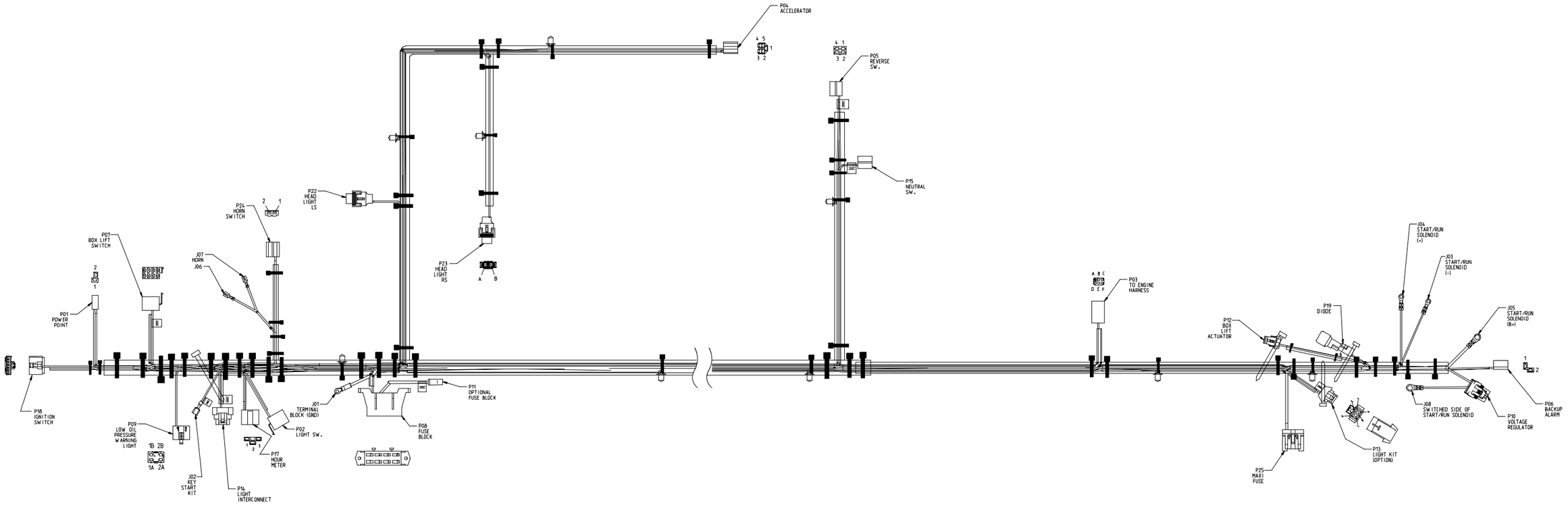

**Workman MD and MDX**
Main Electrical Harness Wiring Diagram
(Serial Number Below 280999999)



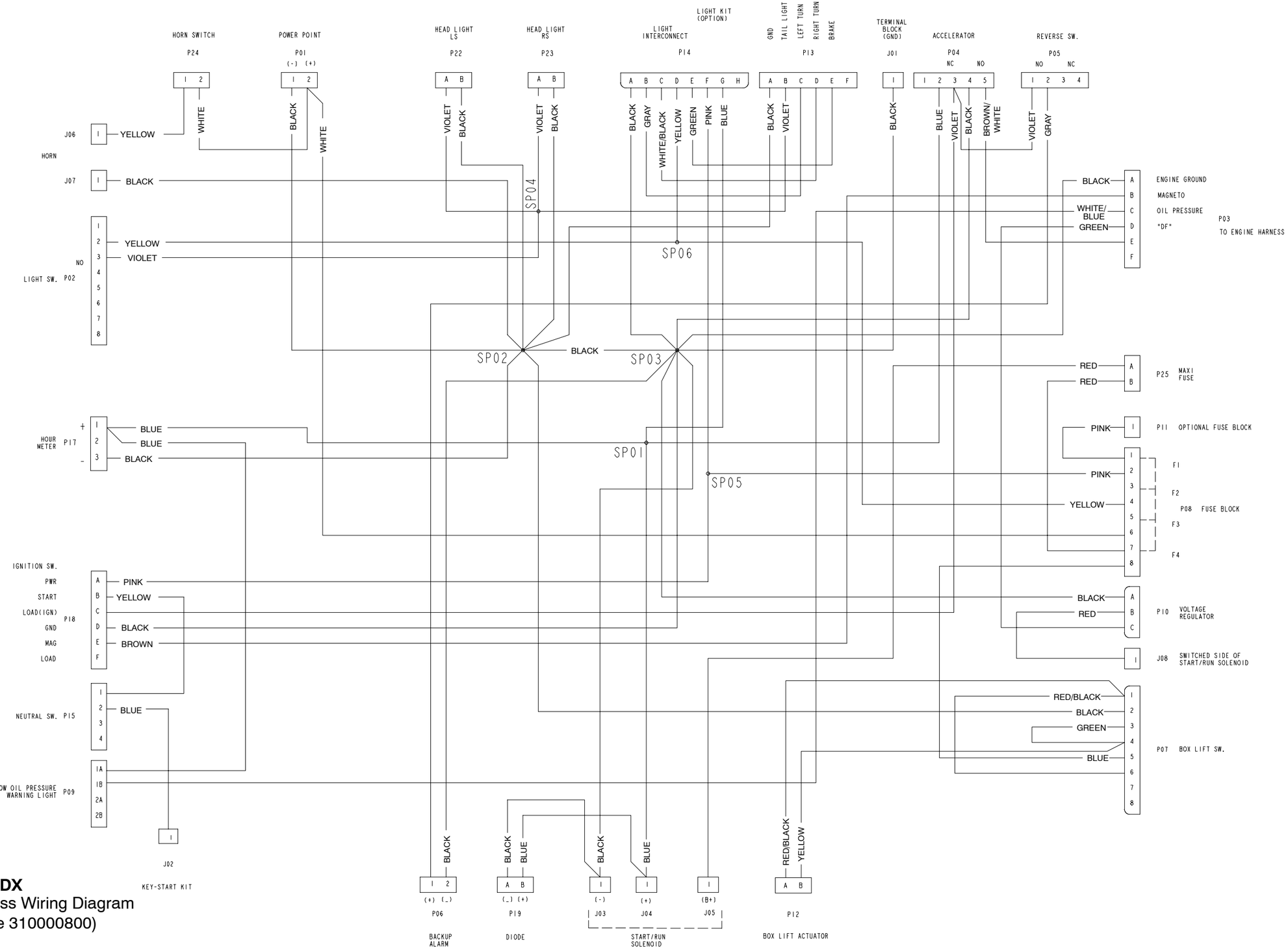

**Workman MD and MDX**
Main Electrical Harness Drawing
(Serial Number From 290000001 to 310000800)



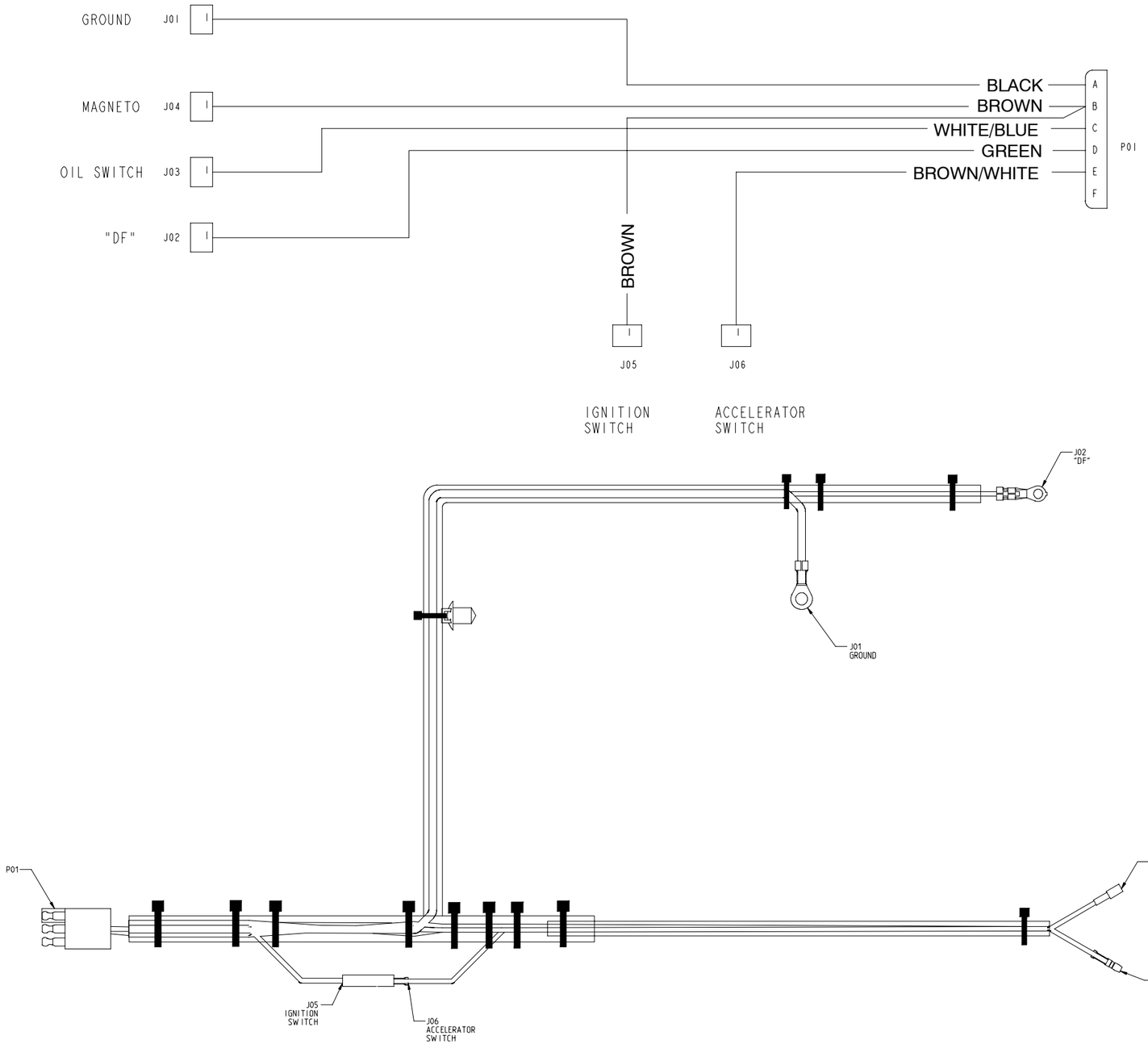

**Workman MD and MDX**
Main Electrical Harness Wiring Diagram
(Serial Number From 290000001 to 310000800)



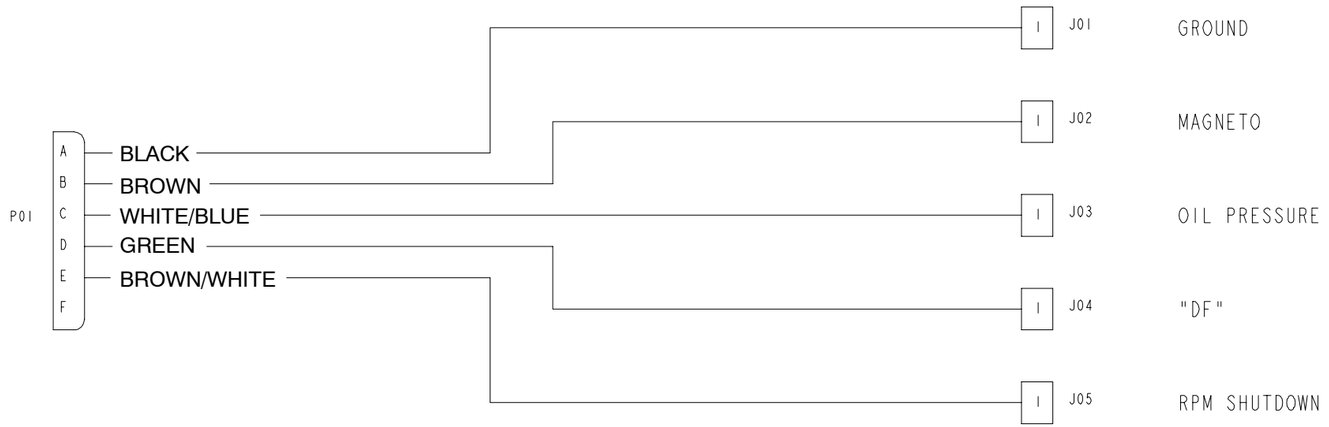

**Workman MD and MDX**
Main Electrical Harness Drawing
(Serial Number Above 310000800)

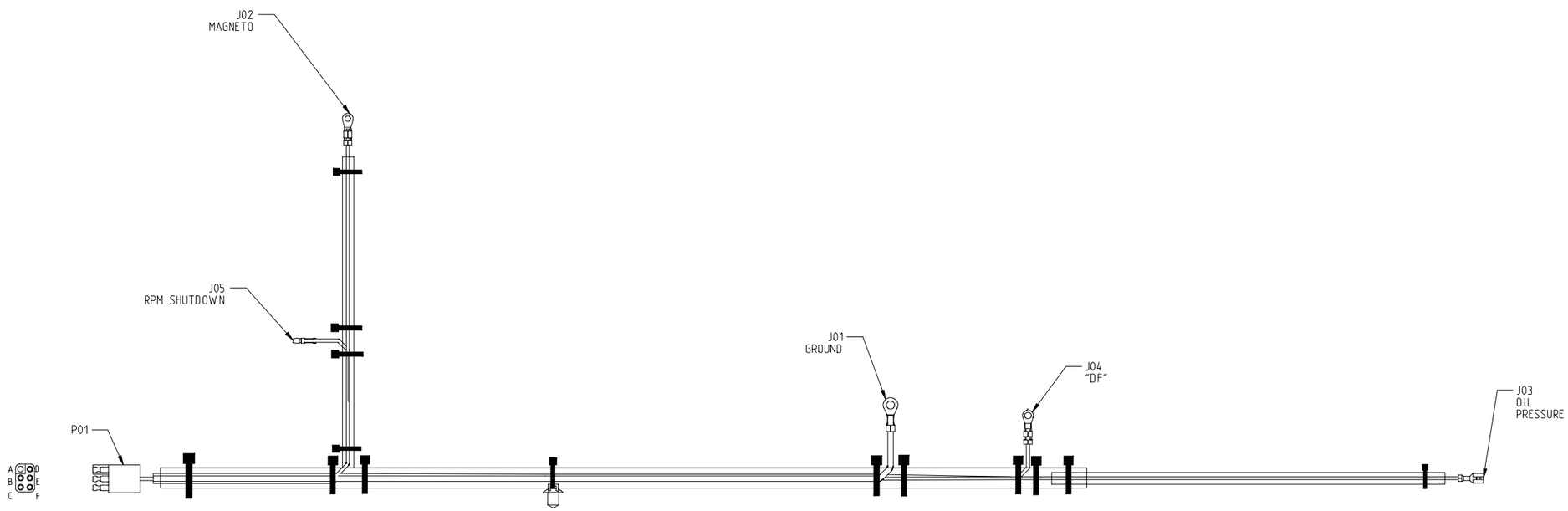



**Workman MD and MDX**
Main Electrical Harness Wiring Diagram
(Serial Number Above 310000800)




**Workman MD**
Engine Electrical Harness




**Workman MDX**
Engine Electrical Harness